bart
impact
program

1977 WORK TRAVEL SURVEY METHODS AND FINDINGS

WORKING PAPER

The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U. S. Department of Transportation, the U. S. Department of Housing and Urban Development, and the California Department of Transportation. Management of the Federally funded portion of the program is vested in the U. S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. Finally, the findings will be interpreted with regard to their implications for the planning of transportation and urban development in the Bay Area and other metropolitan areas.

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BART IMPACT PROGRAM

1977 WORK TRAVEL SURVEY METHODS AND FINDINGS

DECEMBER 1978

WORKING PAPER

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PREPARED FOR

EPARTMENT OF TRANSPORTATION

AND

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

WASHINGTON, D.C.

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NOTICE

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Transportation System and Travel Behavior Project

1977 Work Travel Survey Methods and Findings
Prepared by
Peat, Marwick, Mitchell & Co.

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The Metropolitan Transportation Commission is the prime contractor for the BART Impact Program. Peat, Marwick, Mitchell & Co., is the subcontractor responsible for the Transportation System and Travel Behavior Project.

16. Abstract

BART, the 71-mile Bay Area Rapid Transit System, serving San Francisco, Oakland, Berkeley, and their suburbs, is the first regional-scale rapid transit system to open in the United States in over 50 years. This report is one of a series assessing the impacts of BART on transportation and travel in the Bay Area. It describes the methods and results of a survey of 8,400 persons employed in the areas most accessible by BART. The sample represents 506,000 daily work trips to the survey area. A novel sampling design was used in which self-completion questionnaires were distributed to workers at their workplaces. Detailed information was obtained on the travel mode choices available to workers, the characteristics of their journey-to-work alternatives, and the reasons for their mode choices.

BART's share of journey-to-work trips into the survey area from residences in the primary BART service areas is 18%; bus, 16%; and automobile, 66%. The BART share varies greatly for specific origin-to-destination corridors and trip lengths; BART's highest share is for long-distance commute trips to downtown areas. Of all trips from residences in the primary service area, respondents considered 40% to be possible by BART; BART presently carries about 40% of these possible trips, which suggests a high potential for increased patronage. Typically, relative travel times and reliability of service are among the most important determinants of travelers' mode choices.

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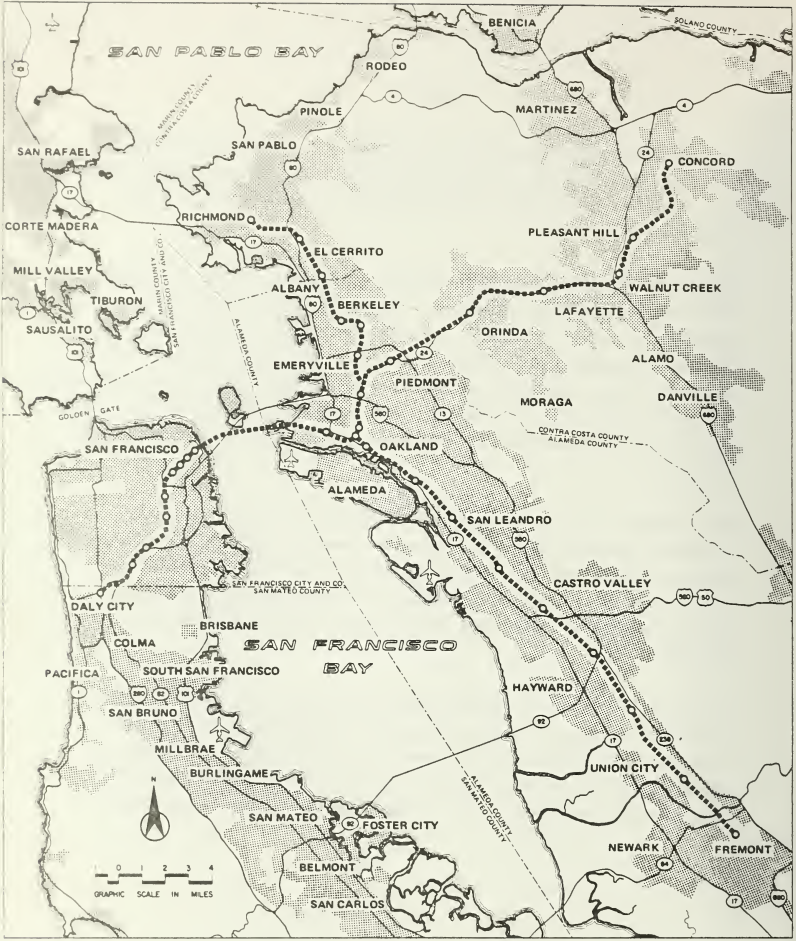
PREFACE

This report describes the methods and findings of a survey of work travel in the San Francisco Bay Area conducted as part of the Transportation System and Travel Behavior Project of the Bay Area Rapid Transit (BART) Impact Program.

Management Information Associates of San Francisco devised the sampling procedures and conducted the survey. Chapter II of the report, which describes the survey procedures, draws heavily from an earlier draft report prepared by Management Information Associates. The survey data were analyzed by Peat, Marwick, Mitchell & Co., of San Francisco. Mr. Joel Markowitz of the BART Impact Program staff of the Metropolitan Transportation Commission, Berkeley, provided guidance and assistance at all stages of the survey and analyses.

The findings of the work travel survey are summarized and discussed in relation to the findings of other studies conducted during the Transportation System and Travel Behavior Project in the final report of the Project: *BART's First Five Years: Transportation and Travel Impacts*, BART Impact Program Document No. DOT-BIP-FR 11-3-78, Peat, Marwick, Mitchell & Co., May 1978.

A complete set of survey data on magnetic tape, with associated documentation, is available to anyone interested in performing more detailed tabulations or analyses than are given in this working paper. Inquiries concerning the survey data should be addressed to the Metropolitan Transportation Commission, Hotel Claremont, Berkeley, California 94705.



LEGEND

BART Lines and Stations

Major Highways and Freeways

Urbanized Areas

SAN FRANCISCO BAY AREA RAPID TRANSIT

SUMMARY AND CONCLUSIONS

Survey Objectives

This report documents the procedures and findings of a survey of journeys to work in the San Francisco Bay Area conducted in June, July, and August 1977. The principal objectives of the survey were to (1) describe overall origin-to-destination commute patterns in major travel corridors as a context for assessing the impacts of the Bay Area Rapid Transit System (BART), (2) describe the journey-to-work mode choices among BART, bus, and automobile made by travelers in the various commute corridors; and (3) explain the reasons for these mode choices.

The estimated total population of workers represented by the survey was 506,000. Some groups of workers were excluded, such as those who work at home or in essentially residential neighborhoods, those who have no regular workplace, and those who work at a location remote from their employer. However, these workers are unlikely to be commuters in the usual sense. The population covered in the survey included most regular commuters for whom BART may be a means of getting to or from work, including those working in the central business districts (CBDs) of San Francisco and Oakland.

Survey Procedures

A novel sampling design was used in which self-completion questionnaires were distributed to workers at their workplaces. The questionnaires requested information on the travel mode choices available to workers, the characteristics of their journeys to work (both for their usual mode and alternative modes), and the reasons for their mode choices.

The sampling design was based on the number of floors of buildings in selected nonresidential blocks in the survey area. From among all 3,718 nonresidential blocks in the survey area, a systematic interval

selection of 308 blocks was made, and, for all workplaces in these selected blocks, the people working on every third floor were enumerated. This enumeration located 1,382 workplaces with an estimated 18,700 workers on the 1,066 floors included. Finally, excluding workplaces that were vacant at the time of the survey and workplaces where the employers refused to cooperate, 14,381 questionnaires were distributed to workers at 901 workplaces. Of these, 8,391 usable questionnaires were returned, representing a 58% response rate. The effective sampling rate of 8,391 in 506,000 is 1 in 60.

The overall 58% response rate is unusually high for a self-completion questionnaire as complex as the one used in the survey. The response rates for different workplaces were found to depend heavily on the extent to which employers cooperated in distributing the questionnaires and encouraging their employees to fill them out. Consequently, every effort was made to persuade employers to cooperate.

Toward the end of the field work, short questionnaires were distributed to obtain information about workers who had not filled out regular questionnaires. Information was requested on the respondent's usual method used to get to work, sex, age, race, and education level. Primarily because of the simplicity of the short questionnaires, the response rate was much higher than for the regular questionnaires.

For a subset of 97 workplaces employing an estimated 1,031 workers, either regular "respondent" or short "nonrespondent" questionnaires were completed for virtually all workers. The characteristics of the "respondents" and "nonrespondents" for the 97 workplaces were compared and used to estimate nonresponse bias in the survey. Based on differences in response rates for various stratifications of these survey data, weighting factors were computed to compensate for nonresponse bias as a function of whether the

respondent (1) usually rode public transit to work, (2) attended college, (3) was male or female, and (4) was white or nonwhite.

Distribution of Work Trip Origins and Destinations

Strictly, the survey sampled workers (rather than work trips). However, the average worker works 5 days a week and makes one round trip to and from work on each work day. Thus, the survey effectively represents the trips made on a typical weekday by the 506,000 workers covered.

Of the 506,000 daily work trips represented, 86% are made from residences in the three BART District Counties of San Francisco, Alameda, and Contra Costa. San Mateo County accounts for another 8%. Fifty-nine percent are made from the five corridors of an area defined as the primary BART service area. These five corridors approximate the catchment areas of the various BART lines.

Nearly half the 506,000 daily work trips are to workplaces in the central business districts (CBDs) of San Francisco (177,700 trips or 35% of the total) or Oakland (61,100 trips, 12%). Workplaces in the industrial areas served by the BART Fremont Line are also the destinations for a large number of surveyed work trips (126,500 trips, 25%). The remainder (140,700 trips, 28%) are to workplace destinations in non-CBD areas of San Francsico and Oakland and to areas served by the Richmond and Concord Lines.

Distribution of Work Travel Modes

BART's share of total surveyed trips is 13%, compared with bus, 17%; automobile, 61%; and other modes (including walking), 9%. Including only trips that begin within the five-corridor BART service area, the shares are: BART, 15%; bus, 14%; automobile, 15%; and other modes, 12%.

BART's share of trips is much higher to the San Francisco and Oakland CBDs than to non-CBD workplace areas. Considering only trips made from origins

within the five-corridor primary BART service area, BART's share of trips to the Oakland CBD is 27% and its share of trips to the San Francisco CBD is 23%. BART's share is largest for long trips, such as those from the Concord Corridor to the San Francisco CBD (where BART's share is 53%) and from the Daly City Corridor to the Oakland CBD (49%). BART's share is smallest for short within-corridor trips, such as those from the Daly City Corridor to non-CBD San Francisco workplaces (8%).

Of work trips from the Daly City Corridor to the San Francisco CBD, 50% are made by public transit (20% by BART, 30% by bus). Another 15% of workers usually walk to work. In the East Bay, there are marked differences in the mode distributions for travel to the San Francisco CBD from the various corridors. For trips from the Concord Corridor to the San Francisco CBD, transit travel is mostly by BART (53% of all trips); only 11% is by bus. This high BART share reflects the availability of direct transbay BART service, relatively infrequent Greyhound parallel bus service, and heavy automobile traffic through the Caldecott Tunnel. In contrast, for travel from the Richmond Corridor to the San Francisco CBD, BART's share is very small (13%), compared with the bus share (53%). This reflects the lack of direct Richmond-to-San Francisco BART service and the availability of good AC Transit transbay bus service.

BART's Share of its Potential Work Trip Market

Although the work travel survey was conducted in zones which are, for the most part, reasonably close to a BART station, some workplaces in the survey area are not effectively served by BART. Similarly, the home locations of many work travelers are considerable distances from BART.

In an attempt to estimate BART's market share relative to the trips it might reasonably be expected to serve, BART trip shares were computed as a percentage of the total number of trips for which BART is possible as well as its share of all trips. (All work trips made by respondents who

answered "yes" to the question "Is it possible for you to travel to work on BART?" were considered as "BART possible" trips in this analysis.) Of the 506,000 daily work trips represented in the survey, 167,200 or 33% are considered possible BART trips. Of the 298,200 trips made from residences in the primary BART service area, 118,300 or 40% are considered possible BART trips.

Overall, BART is the first choice mode for 39% of all trips that could (according to the assumptions of this analysis) possibly be made by BART. For work trips from the Concord Corridor to the San Francisco CBD, BART's share of actual trips (53%) is almost as high as its share of potential trips (55%), because BART is regarded as a possible alternative by virtually all commuters. By contrast, BART's share of potential trips from the Daly City Corridor to the San Francisco CBD (52%) is much higher than its share of actual trips (20%), because BART is regarded as a possible alternative by a smaller proportion of commuters.

Journey-to-Work Mode Choices

Of daily work trips made by people whose usual mode is automobile, about 89% are typically made by automobile on a given day; that is, people whose usual mode is driving seldom use other means of getting to work. Of work trips made by people whose usual mode is bus, only 81% are typically made by bus on a given day; that is, a higher proportion of "usual" bus users sometimes travel to or from work by other modes (mostly automobile). This tendency is even more marked in BART's case. Of trips made by people whose usual mode is BART, typically only 65% are actually made by BART on a given day; the other 35% are made by bus or automobile (about equally).

Of all workers who specify BART as their first choice (usual) mode, 59% specify automobile as their second choice mode (51% drive alone, 8% carpool), and 36% specify bus as their second choice mode. Very few commuters give walking (2%) or other modes (3%) as their second choice. (Trips for which "no second choice" is indicated are excluded.) These percentages may be

taken as estimates of the modes that current BART work travelers would most likely use if BART were not available, given current bus service levels, highway traffic congestion, and other transportation costs.

Of workers whose first choice mode is bus, 57% specify automobile as their second choice (47% drive alone, 10% carpool), and 21% specify BART as their second choice. Significant percentages of those whose first choice is bus specified walking (10%) or other modes (11%) as second choice, reflecting the higher proportion of short commute trips made by bus compared with BART.

Of workers who specify drive alone or carpool as their first choice, 30% and 45%, respectively, specify BART as their second choice. These percentages suggest a large "market" of potential BART riders who currently drive.

Characteristics of Journeys to Work

The average time for the trip to work is shortest for those who drive alone (22 minutes), and longest for those who use BART (51 minutes). Although 83% of all drive-alone work trips are completed in 30 minutes or less, only 18% of BART trips are completed in the same period. BART's share of long-duration trips is correspondingly high.

It takes the typical BART rider an average of 13 minutes to reach the BART station from home, 3 minutes longer than it takes the average bus rider to travel to the bus stop. The average time from BART station to workplace destination (9 minutes) is similar to the average time from bus stop to workplace destination (8 minutes).

However, the distributions of modes used by commuters to get from home to BART or home to bus are very different. For BART trips, the distribution is walking, 19%; bus, 30%; and automobile, 52%. The distribution of modes used to get from home to the (principal) bus mode is walking, 81%; bus, 9% and 10%, automobile. At the destination end of the trip, the mode distribution from BART to workplace is walking, 84%; and bus, 16%. From bus to

the workplace, the distribution is similar (walking, 82%; and bus, 18%). Corresponding to the high percentage of BART riders who use bus or automobile to get to the station, BART journeys are much more likely to require a transfer between vehicles than are bus journeys.

The average BART round trip commute fare ($1.52) is almost double the average bus round trip commute fare ($0.83). Twenty-nine percent of BART work travelers pay less than $1.00 in fares daily; the corresponding percentage among bus commuters is 75%.

Reasons for Choices between BART and Bus

As indicated by the survey, the total population of commuters choosing between BART and bus (as their first or second choice modes) is 31,800. Of these commuters, 54% usually choose BART over bus, and 46% usually choose bus over BART.

People choosing BART over bus report an average 11-minute one-way trip time advantage by BART (46 minutes by BART, 57 minutes by bus), but they pay much more for the trip than if they take the bus, and typically have to transfer between vehicles more often in their BART trip.

Examination of the way travelers rate their satisfaction with the various attributes of the BART and bus alternative shows that BART has the greatest advantage over bus for the attributes of security, ability to do what you want while traveling, flexibility, and total travel time. Bus has the greatest advantage over BART for the attributes of dependability, cost, chance of getting a seat, and time spent walking.

The factors people say are important in their travel decisions between BART and bus vary as a function of their first choice mode. For example, travel cost is considered the most important of all factors by people choosing bus over BART, but it is mentioned by relatively few people

choosing BART over bus. Similarly, dependability is given a high importance rating by people choosing bus over BART, but a much lower rating by people choosing BART over bus.

To some extent, these differences may reflect travelers' justifications of their own decisions. That is, people who choose BART over bus may be unwilling to admit that travel cost and dependability are important to them, given that they know (or judge) the bus to be less expensive and more reliable. However, the differences in the importance rankings for BART and bus choosers also reflect the different preferences of the two groups. People to whom cost is important are less likely to choose the more expensive BART alternative (other things being equal), and people to whom reliability is important are less likely to choose the less reliable BART alternative.

Overall, travel time (particularly time spent walking to and from, and waiting for, the bus or BART) and the related attribute of dependability appear to be overwhelmingly the most important considerations to people choosing between BART and bus for their work journeys. Comfort and other qualitative differences between BART and bus (on which great emphasis was placed in the design of BART) are not indicated as nearly such important factors in travelers' mode choices.

Reasons for Choices between BART and Automobile

A total of 91,000 commuters represented in the survey specify BART and driving alone as their first or second choice mode. Of these, 27% usually choose BART over driving, and 73% choose driving over BART.

The average journey to work on BART takes much more time than the alternative trip by automobile, both for people who usually drive and people who usually take BART. For people who usually drive, the alternative trip would take twice as long by BART (27 minutes driving, 55 minutes by BART).

For people who usually take BART, the BART trip is 18 minutes longer than the alternative trip by automobile (52 minutes by BART, 34 minutes driving). However, this longer trip time is offset by the much lower trip cost by BART. Average BART trip fares are considerably lower than average parking and bridge toll costs alone (without any allowance for gasoline and other running costs).

Travelers' satisfaction with BART is highest (relative to the automobile) for the opportunity it provides them to do what they want while traveling, and for its cost; satisfaction is lowest for its dependability and total travel time.

As with the choices between BART and bus, there are large differences in the mode choice factors reported as important, depending on whether BART or the automobile is the first choice mode. Among people who choose BART over driving, cost and dislike for driving in congested traffic are listed most frequently as important factors. Reliability is mentioned as important by a very small number of people choosing BART over driving. In contrast, reliability is one of the most important attributes listed by people choosing driving over BART.

In addition, there is an obvious difference in the importance attached to travel time and time-related attributes by the different groups. Among people who choose BART over driving, the travel time, waiting time, inconvenience, and unreliability factors together account for only 13% of responses. In contrast, among people who choose driving over BART, the figure is 63%.

Apparently, people who elect to ride BART generally accept that it takes longer and is less reliable than driving, but feel that these disadvantages are outweighed by the advantages of BART--primarily its lower cost and the opportunity it affords to commuters to avoid driving in congested traffic and so make better use of their time while traveling. As with the BART-bus choice sample, the "qualitative" attributes of safety,

security, comfort, and crowding are reported by very few people as important in their choices between BART and the automobile.

Conclusions

The importance travelers attach to the various service attributes in their travel choice decisions varies among individuals and depends on the specific mode choices available, but generally the important determinants of choice are the time spent traveling and the "quantitative" service attributes: the time travelers must spend getting to and from the BART station or bus stop, time spent waiting, total journey time, the number of transfers required, reliability of service, and, especially among those who make a choice between BART and bus, the cost of the journey. Comfort and the other qualitative aspects of service do not appear to be important considerations in most people's current choices between BART and bus or BART and automobile.

Accordingly, the use of BART for journeys to and from work primarily reflects the advantages BART provides relative to bus or automobile with regard to the "quantitative" aspects of service. BART has improved peak-period transit travel times most for long-distance commute trips, particularly to workplaces in the central business districts of San Francisco and Oakland. Correspondingly, the predominant use of BART is for these long-distance trips.

Of all work trips made from residences in the primary BART service area, 40% are reported by survey respondents as being possible by BART. Currently, BART is the usual first choice mode for 39% of these possible trips--suggesting a significant potential market of BART trips. However, fairly large improvements in overall door-to-door BART travel times and other aspects of service are indicated as being necessary to realize this potential if other factors remain unchanged. In large part, BART's ridership is constrained by the intrinsic limitations of the service BART can provide--particularly the requirement that most people must transfer between vehicles in the course of their journeys.

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SAN FRANCISCO BAY REGION

CENTRAL AREA

Metropolitan Transportation Commission

BART: The Bay Area Rapid Transit System

Length: The 71-mile system includes 20 miles of subway, 24 miles on elevated structures and 27 miles at ground level. The subway sections are in San Francisco, Berkeley, downtown Oakland, the Berkeley Hills Tunnel and the Transbay Tube.

Stations: The 34 stations include 13 elevated, 14 subway and 7 at ground level. They are spaced at an average distance of 2.1 miles: stations in the downtowns are less than one-half mile apart, while those in suburban areas are two to four miles apart. Parking lots at 23 stations have a total of 20,200 spaces. There is a fee (25 cents) at only one of the parking lots. BART and local agencies provide bus service to all stations.

Trains: Trains are from 3 to 10 cars long. Each car is 70 feet long and has 72 seats. Top speed in normal operations is 70 mph with an average speed of 38 mph including station stops. All trains stop at all stations on the route.

Automation: Trains are automatically controlled by the central computer at BART headquarters. A train operator on board each train can override automatic controls in an emergency.

Magnetically encoded tickets with values up to $20 are issued by vending machines. Automated fare gates at each station compute the appropriate fare and deduct it from the ticket value.

Fares: Fares range from 25 cents to $1.45, depending upon trip length. Discount fares are available to the physically handicapped, children 12 and under, and persons 65 and over.

Service: BART serves the counties of Alameda, Contra Costa and San Francisco, which have a combined population of 2.4 million. The system was opened in five stages, from September 1972 to September 1974. The last section to open was the Transbay Tube linking Oakland and the East Bay with San Francisco and the West Bay.

Routes are identified by the terminal stations: Daly City in the West Bay, Richmond, Concord and Fremont in the East Bay. Trains operate from 6:00 a.m. to midnight on weekdays, every 12 minutes during the daytime on three routes: Concord-Daly City, Fremont-Daly City, Richmond-Fremont. This results in 6-minute train frequencies in San Francisco, downtown Oakland and the Fremont line where routes converge. In the evening, trains are dispatched every 20 minutes on only the Richmond-Fremont and Concord-Daly City routes. Service is provided on Saturdays from 9 a.m. to midnight at 15-minute intervals. Future service will include a Richmond-Daly City route and Sunday service.* Trains will operate every six minutes on all routes during the peak periods of travel.

Patronage: Approximately 146,000 one-way trips are made each day. Approximately 200,000 daily one-way trips are anticipated under full service conditions.

Cost: BART construction and equipment cost $1.6 billion, financed primarily from local funds: $942 million from bonds being repaid by the property and sales taxes in three counties, $176 million from toll revenues of transbay bridges, $315 million from federal grants and $186 million from interest earnings and other sources.

March 1978

*Sunday service began in July, 1978

I. INTRODUCTION

Objectives and Scope

The 1977 Work Travel Survey was a survey of journeys to work in the San Francisco Bay Area conducted in June, July, and August 1977 as part of the Transportation System and Travel Behavior (TSTB) Project of the Bay Area Rapid Transit (BART) Impact Program. The survey covered nearly all workplaces to which journeys are (or could be) made by BART, including the central business districts (CBDs) of San Francisco and Oakland.

A novel sampling design was used in which self-completion questionnaires were distributed to workers at their workplaces. The questionnaires requested information on the travel mode choices available to workers, the characteristics of their journeys to work (both for their usual mode and alternative modes), and the reasons for their mode choices. Responses from 8,391 workers (representing 2% of the 505,977 workers sampled) were analyzed, providing a comprehensive picture of work travel by automobile, bus, BART, and other modes.

The objectives of this report are to:

1. Document the design, sampling, conduct, and control procedures used in the survey for the benefit of those planning future workplace-based travel surveys in the Bay Area or elsewhere.

2. Document response to the survey and the weighting factors developed to compensate for nonresponse bias.

3. Describe overall origin-to-destination commute patterns in the major travel corridors of the BART service area as a context for assessing BART's impacts and for

analyzing other more general Bay Area transportation planning issues.

4. Describe the mode choices available to travelers in the various commute corridors, and summarize the shares of work trips being made by automobile, bus, BART, and other modes.

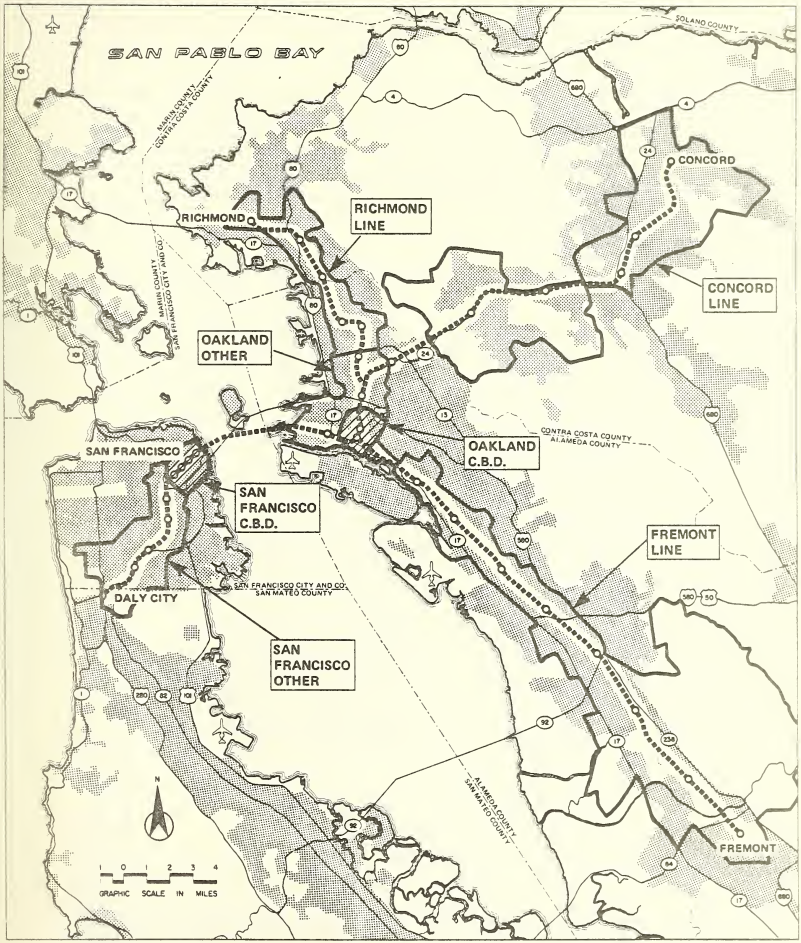
5. Compare the characteristics of work trips being made by automobile and transit modes, and the characteristics of the travelers making them; and explain the reasons for peoples' mode choices among BART, bus, and automobile for their journeys to work.

Areas and Corridors Analyzed

Workplace Areas. Workplaces were sampled in an area defined by an aggregation of 88 traffic zones.* For analysis purposes, this work travel survey area was divided into seven workplace (destination) areas, as shown in Figure 1 and Table 1:

1. San Francisco CBD
2. San Francisco Other
3. Oakland CBD
4. Oakland Other
5. Richmond Line
6. Concord Line
7. Fremont Line

*Zones referred to in the report are those defined by the Metropolitan Transportation Commission (MTC) 440 traffic zone system for the 9-county San Francisco Bay Region, as shown in Appendix C.



LEGEND

BART Lines and Stations

Major Highways and Freeways

Urbanized Areas

FIGURE 1

WORK TRAVEL SURVEY AREA

Table 1

DEFINITION OF WORKPLACE (DESTINATION) AREAS

Area	Zone Definition[a]	1975 ABAG Total Employment[b]	1977 Workplace Survey Employment[c]
1. San Francisco CBD	382, 383, 419-430 (14 zones)	265,230	177,668
2. Other San Francisco Workplaces	365, 373-377, 379, 384-392, 395, 396, 414, 418, 431 (21 zones)	84,742	27,284
3. Oakland CBD	142-144 (3 zones)	47,994	61,135
4. Other Oakland Workplaces	136-141, 145 (7 zones)	56,038	39,141
5. Richmond Line Workplaces	116, 118, 119-121, 125, 128-130, 133, 134 (11 zones)	61,186	40,326
6. Concord Line Workplaces	90-93, 96, 98, 100-105 (12 zones)	52,880	33,991
7. Fremont Line Workplaces	159, 161, 171-173, 175, 176, 178, 179, 185, 187, 189, 191-195, 197, 198, 204 (20 zones)	109,116	126,432
		677,186	505,977

a. Zones are as defined by the MTC 440 regional traffic zone system, see Appendix C.
b. Source: ABAG, Provisional Series 3 Projections, March 1977.
c. Estimated population sampled in BART Impact Program 1977 Work Travel Survey.

As shown in Table 1, total employment in the work travel survey area in 1975 was estimated to be 677,186,* and the total population of workers sampled in the 1977 survey was estimated to be 505,977. The reason for the difference between the estimates, aside from the two different years and estimating errors, is that the work travel survey did not cover all workers. Among groups of workers excluded from the survey were:

- Domestic servants and others who work in essentially residential areas, people who work at home or in offices in residential buildings, and people who work in neighborhood stores and gas stations

- People who do not report to a regular workplace or dispatching center, such as self-employed plumbers, electricians, contractors, and truckers, and some messengers, salesmen, and agents

- Some categories of temporary workers, such as those who work for temporary agencies

- Workers who work at locations remote from their employers, such as some construction site workers and office cleaning workers

- People who work in churches and church schools

- Street vendors

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*Association of Bay Area Governments, *Provisional Series 3 Projections of Population, Housing, and Land Uses: San Francisco Bay Region*, March 1977.

These workers are unlikely to be commuters in the usual sense. They were deliberately omitted from the sample because the cost of including them would have been out of proportion to the numbers of commuters likely to be found. The population covered in the work travel survey is thought to include nearly all of the regular commuters for whom BART may be a means of getting to or from work.

Residence Areas. For analysis purposes, the residence zones of survey respondents were also grouped into seven home (origin) areas, as defined in Table 2:

1. Daly City Corridor
2. Oakland Corridor
3. Richmond Corridor
4. Concord Corridor
5. Fremont Corridor
6. BART Express Bus Service Area
7. Other Areas

The first five home areas (or corridors) are shown in Figure 2. Together, these five corridors form a 132-zone area defined as the "primary BART service area" for the purposes of TSTB Project analyses. The primary BART service area covers 322 square miles, most of it developed. It had a resident population of 1,606,000 in 1975, and accounts for the origins of 80% of all BART riders. The five corridors approximate the catchment areas of the various BART lines. Socioeconomic characteristics of the five corridor populations are summarized in Table 3.

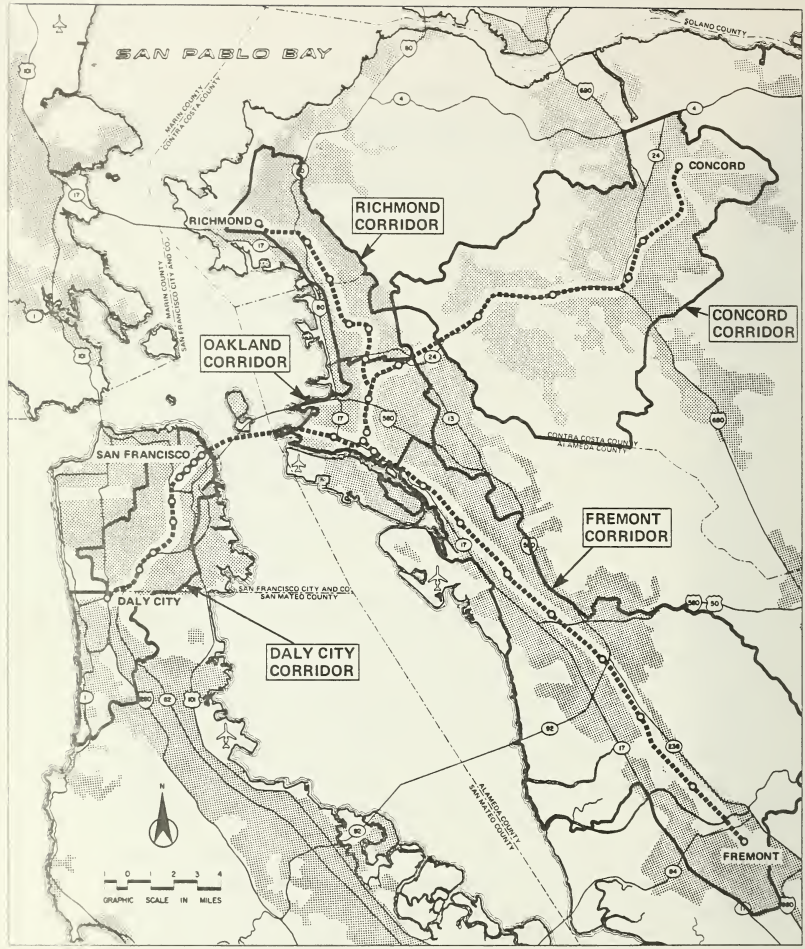
"BART Express Bus" service is provided between BART stations and portions of Alameda and Contra Costa Counties beyond the immediate service area of the BART lines. Service on five Express Bus routes, as shown in Figure 3, began in late 1974. The area defined in this report as the BART express bus service area comprises 27 zones approximating the catchment areas of these five bus routes.

Table 2

DEFINITION OF HOME (ORIGIN) AREAS

Area	Zone Definition[a]
1. Daly City Corridor	347, 361-365, 372-377, 379, 381-392, 394-397, 399, 413-435 (53 zones)
2. Oakland Corridor	136-149 (14 zones)
3. Richmond Corridor	113, 115, 116, 118-122, 124, 125, 128-130, 132-134 (16 zones)
4. Concord Corridor	89-105 (17 zones)
5. Fremont Corridor	155, 156, 159-161, 166, 171-179, 181, 184, 185, 187-198, 203, 204 (32 zones)
6. BART Express Bus Service Area	73-80, 82, 84-88, 106, 108, 109, 110, 111, 114, 205, 206, 208, 211-214 (27 zones)
7. Other Areas	All other zones

a. Zones are as defined by the MTC 440 regional traffic zone system, see Appendix C.



LEGEND

BART Lines and Stations

Major Highways and Freeways

Urbanized Areas

FIGURE 2
PRIMARY BART SERVICE AREA

Table 3

SOCIOECONOMIC CHARACTERISTICS OF PRIMARY BART SERVICE AREA[a]

	BART Service Corridors Comprising Primary BART Service Area					
	Daly City Corridor	Richmond Corridor	Concord Corridor	Fremont Corridor	Oakland Corridor	Total All Corridors
Number of Zones	53	16	17	32	14	132
Socioeconomic Characteristic						
Sex, 1975[b]						
Male	49.9%	48.5%	49.1%	48.7%	48.2%	49.1%
Female	50.1	51.5	50.9	51.3	51.8	50.9
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Age, 1975[b]						
Under 16	21.6%	23.4%	32.1%	31.5%	19.8%	26.3%
16 to 17	2.6	2.9	4.5	3.9	2.7	3.3
18 to 24	13.2	18.8	9.4	12.0	14.6	13.2
25 to 34	15.4	15.1	12.5	13.3	13.3	14.1
35 to 44	11.8	9.3	13.8	11.7	9.7	11.5
45 to 54	12.1	11.2	13.3	12.0	12.0	12.1
55 to 64	10.9	9.2	7.4	7.9	11.9	9.3
Over 64	12.4	10.1	7.0	7.7	16.0	10.2
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Ethnic/Racial Category, 1975[b]						
White	55.2%	64.6%	92.5%	65.1%	52.0%	64.7%
Black	13.4	20.8	0.3	12.5	34.7	14.3
Spanish-American	17.5	7.8	5.7	18.3	6.0	13.6
Other	13.9	6.8	1.5	4.1	7.3	7.4
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Mean Family Income, 1969[c]	$11,677	$11,970	$15,794	$11,445	$12,107	$12,302
Number of Families, 1975[d]	106,681	47,970	61,098	127,763	36,722	380,234
Percent of Families Below Poverty Level, 1970	10.5%	8.8%	3.3%	8.1%	11.2%	8.4%
Number of Workers, 1970[e]	220,464	95,813	81,943	179,222	67,527	644,969
Work Trip Mode, 1970[f]						
Automobile	53.4%	72.5%	85.8%	85.7%	65.3%	70.6%
Transit	30.1	11.4	6.6	7.4	19.1	16.9
Other	16.5	16.1	7.6	6.9	15.6	12.5
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Population, 1970	509,318	240,934	218,700	481,486	170,099	1,620,437
Total Population, 1975	494,805	219,542	233,975	499,254	158,090	1,605,666
Percent Change in Population, 1970 to 1975	-2.8%	-8.8%	7.0%	3.7%	-7.1%	-0.9%

a. See text for definition of areas.
b. Percentage distributions from the 1970 census were applied to 1975 population totals for each zone to estimate the number of people in each category in 1975. The percentages in the table are based on aggregates of the resulting 1975 estimates for each category.
c. Weighted average computed by weighting census tract averages by number of families in each census tract, 1970.
d. The number of families obtained from the 1970 census adjusted according to the percentage change in the total population from 1970 to 1975.
e. The number of workers in 1970 as obtained from the 1970 census and used as the base for work trip mode percentages (footnote f).
f. Automobile: driver or passenger in private automobile; transit: bus, streetcar, or train; other: walked to work, worked at home, or other mode.

Sources: U.S. Census of Population and Housing, census tract data for 1970.
Association of Bay Area Governments (ABAG) Provisional Series 3 Projections of population and employed residents for 1975 (March 1977).

LEGEND

BART Lines and Stations

Major Highways and Freeways

Urbanized Areas

FIGURE 3

BART EXPRESS BUS LINES

Origin-to-destination trip patterns analyzed in the report are defined in terms of the above origin and destination areas or aggregates thereof.

Analyses that refer to travel from (or within) the BART service area describe work trips beginning in the first five origin corridors only. Workers making trips from homes within this BART service area (298,250) represent 59% of all 505,977 workers covered by the survey.

Strictly, the survey sampled workers (rather than work journeys). However, as documented in Chapter IV, the average worker works five days a week and makes one (round) trip to and from work on each work day. Thus, the number and characteristics of all trips made by the 505,977 workers covered by the survey are very similar to the number and characteristics of all work trips made on a typical weekday. Accordingly, the terms "workers" and "work trips" (or "work journeys") are used interchangeably in the report to describe the survey population.

II. SURVEY PROCEDURES

Sampling Procedures

The sampling design for the survey was based on the number of floors of buildings in selected nonresidential blocks in the survey area. From among all 3,718 nonresidential blocks in the survey area, a systematic interval selection of 308 blocks was made, and, for all workplaces in these selected blocks, the number of people working on every third floor was enumerated. This enumeration located 1,382 workplaces with an estimated 18,700 workers on the 1,066 floors included. Excluding workplaces that were vacant at the time of the survey and workplaces where the employers refused to cooperate, 14,381 questionnaires were distributed to workers at 901 workplaces; 8,391 usable questionnaires were returned, representing a 58% response rate. The effective sampling rate of 8,391 in 505,977 is about 1 in 60. Details of the sampling procedures are given in the following paragraphs. Survey questionnaires and other survey materials are presented in Appendix A.

Selection of Nonresidential Blocks. It was decided that sampling all workers in the survey area would require a disproportionate effort to locate and contact the relatively small number of workers employed in essentially residential neighborhoods. Consequently the survey included only nonresidential blocks.

Nonresidential blocks were defined as those having at least one lot devoted entirely to commercial, industrial, or public use (excluding parks, playgrounds, golf courses, gas stations, or unattended parking lots). For purposes of this definition, buildings which were part commercial and part residential were considered residential. (Businesses in such part commercial buildings were included in the survey sample whenever the block in which they occurred qualified for inclusion in the

sample, but they did not contribute toward defining the block as nonresidential.)

Zoning maps proved impractical for determining which blocks should be considered nonresidential because substantial differences between zoning and actual land use occurred. In San Francisco, reasonably current maps showing the land use of each parcel are maintained by the City Planning Department. These maps were used as the basis for categorizing all blocks in San Francisco. In the remainder of the survey area, a combination of methods was used as appropriate for different areas: land use maps were used as a guide where available, interviews were conducted with city and county planners, and onsite inspections were made.

After all blocks in the survey area were categorized as eligible or not eligible for inclusion in the survey sample, a test was conducted in the San Francisco portion of the survey area to measure the extent to which errors or delays in updating the San Francisco land use maps might lead to the exclusion of eligible workers from the survey sample.

A systematic sample was drawn consisting of every eighth block in San Francisco shown by the land use maps as having no parcel devoted entirely to commercial, industrial, or public use but having some lots with partial nonresidential use. Also included in the sample was every sixtieth block shown by the land use maps to be entirely residential. Enumerators went to these blocks and made a count of the number of people employed in nonresidential buildings in each block, including persons employed in buildings that did not exist when the land use maps were drawn, and those employed in places shown on the land use maps as partially nonresidential.

The results of the test suggested that including only nonresidential blocks (as defined using the land use maps) gave rise to an error of no more than about 3% in the San Francisco part of the survey area. A similar check was not considered necessary in the East Bay, because the

categorization there was based more on onsite observation and less on sources that might have been out of date.

Selection and Enumeration of Blocks. After the exclusion of residential blocks as described above, 3,718 blocks remained in the survey area. These were numbered in order geographically, and a systematic interval selection of 412 blocks was made. (This number included an allowance for any blocks that might have to be eliminated later because they were found to contain no workplace.)

A block enumeration sheet (Figure A-1) was prepared for each of the 412 selected blocks. These sheets showed the block number, city, county, zone number, and street boundaries of each block.

Field workers then observed and listed the addresses and number of floors of all buildings in the enumerated blocks currently used for business or other employment, (including those unoccupied floors that appeared to have a reasonable potential for being reoccupied for business).

Of the 412 blocks selected as probably containing workplace buildings, 308 actually contained workplace buildings. The enumeration showed 3,200 floors in these buildings containing space that appeared suitable for business.

Selection and Enumeration of Floors. After completing the block enumeration sheets, a floor enumeration sheet (Figure A-2) was prepared for every third floor in the list of 3,200 floors. Enumerators went to each selected floor, and listed names of companies, names of persons to contact for cooperation in the survey, nature of businesses, phone numbers, zip codes, and numbers of male and female employees; and noted the initial degree of cooperation obtained.

Where an accurate count of male and female employees could not be obtained, enumerators made an estimate. In the case of large employers, it was found that the best method of obtaining accurate employee counts was to have the enumerators visit the premises to locate the floor or floors of interest, and then to telephone the personnel manager of the company involved (who was often at another location) for the detailed information.

In the case of small businesses that were found locked and that might not still be in business, a second attempt was made at a different time on another day. If no one answered, two further phone calls were made before the employer was considered to be no longer in business.

The enumeration located 1,382 workplaces (on 1,066 floors) with an estimated 18,700 workers.

Preparation of Workplace Cards. A card was filled out for each of the selected workplaces for later use by field workers as they sought employer cooperation and handled questionnaire distribution and collection (Figure A-3). Each card contained the name of the employer, telephone number, address, city, floor number, estimated number of workers, person to contact, and his or her title. Spaces were also provided to fill in dates of mailing, phone calls, appointments, and questionnaire pick-ups.

Questionnaire Design and Pretesting

The intent of the survey was to obtain a comprehensive set of information about respondents jobs, their reasons for job choice, work hours, home locations, available journey-to-work mode choices, travel times, travel costs, and other characteristics of the available choices, and basic socioeconomic information. This information requirement implied a long and complicated questionnaire.

At the same time, the survey design called for a self-completion questionnaire that would be completed by a large group of people varying widely in education level and even literacy. This required a questionnaire that would be easy to read, understand, and fill out. Because the questionnaire was to be distributed (and probably completed by most respondents) at work and the cooperation of employers was required, the time needed to fill out the questionnaire had to be reasonably short.

It was decided initially that the questionnaire should be limited to four 8-1/2 inch by 11 inch pages of well-spaced type. To allow the necessary questions to be fitted into this space, a columnar questionnaire format was developed for pretesting. It was recognized that the unusual format of the questionnaire might make it difficult for many people to complete. Therefore, three different versions of the questionnaire were printed for pretesting. They differed primarily in typographical layout and in the way instructions were given to the respondent. One of the pretest questionnaires is included as Figure A-4.

Initial Pretest Results. For the questionnaire pretest, 29 employers with 372 employees were systematically selected from the sample floors. After soliciting cooperation by mail and telephone, questionnaires (in three versions) were distributed at the end of April 1977 and collected early in May. At the time questionnaires were collected, employers and some workers were interviewed to determine if they had had difficulty in following the questionnaire and answering questions properly.

The results of the pretest were disappointing. Only 164 questionnaires (44%) were returned, and most of these were improperly completed. Interviews with people who had filled out questionnaires, observation of people as they filled them out, and examination of the returned questionnaires showed that there was a high rate of misunderstanding how the

questionnaire should be completed (for all three versions). It was also clear that many people did not fill out the questionnaire at all because it gave the appearance of requiring considerable study and effort by the respondent.

Testing the Revised Questionnaire. In developing a revised questionnaire, it was decided to keep essentially the same questions as in the pretest questionnaire, but to alter the format to an 8-page 8-1/2 inch by 11 inch booklet. The revised questionnaire is shown in Figure A-5. Twenty-seven employers, with 354 employees, were given the revised questionnaire to complete late in May. This time, 263 (75%) were returned completed, and there appeared to be no major problems in completing the questionnaire properly. As a result it was decided to use the revised questionnaire format for the survey. (Questionnaires completed in the second pretest were included in the survey sample.)

Methods of Working with Employers. The two pretests served not only to ensure a workable questionnaire, but also to allow effective methods of handling the field work to be developed. Employers were initially contacted by mail, telephone, or personal visit, and various methods of handling the survey and follow-up were discussed with employers.

In nearly every case, the first contact with the employer was a letter from the Executive Director of the Metropolitan Transportation Commission explaining the purpose of the survey and requesting the employer's cooperation (Figure A-6). Other materials tested in the pretest and later used in the survey were a follow-up contact letter, envelopes for returning questionnaires (to keep answers confidential), and listing sheets for use by the employer (Figures A-7, A-8, and A-9).

Conducting and Controlling the Survey

Preliminary Mailings and Telephone Calls. Selected employers were sent a copy of the letter from the Metropolitan Transportation Commission a week or 10 days before the first planned contact by survey field workers. Employers of appreciable size were telephoned to solicit cooperation, to set up an appointment for the delivery of questionnaires and other materials, and to discuss the method for distributing and picking up questionnaires. Some small places of business were contacted personally without a prior telephone call. For several large employers, a further contact letter was required, and the matter of cooperation in the survey was referred to higher levels of management for approval.

Distribution of Questionnaires. At the time employers were personally contacted by field workers and agreed to cooperate in the survey, a method of handling the survey at each establishment was worked out. Larger employers were urged to use sheets listing employees so questionnaire distribution and collection could be carefully controlled. In many cases, "floor supervisors" were appointed by management to handle questionnaire distribution and collection. A number of large employers sent written notices to employees on the selected floors, pointing out the value of the survey and requesting cooperation. One published an article in its employee newsletter requesting cooperation.

Early experience in the field indicated that the shorter the period between the distribution and collection of questionnaires, the better the return, so employers were urged to request that questionnaires be returned as soon as possible.

To deal with language problems, a bilingual Spanish-speaking field worker and a bilingual Chinese-speaking field worker were employed. In some cases, these field workers were able to enlist the help of bilingual

employees to assist other employees in completing questionnaires; in other cases, they conducted complete personal interviews.

At the time questionnaires were distributed to an employer, a date was set for personal pick-up of the completed questionnaires. (Early in the field work it was learned that mail-in of questionnaires did not produce satisfactory returns). A telephone call was usually made to the contact person at each workplace before the collection date to determine whether the questionnaires had been distributed and collected by the employer as scheduled and to confirm the pick-up appointment. In most cases, particularly among larger firms, not all expected questionnaires were completed at the time of the first pick-up. A date was then set for pick-up of the remainder. In some cases, after several visits were made to collect questionnaires, return envelopes were left with the request that further questionnaires be mailed in.

Methods that Obtained High Response Rates. During the survey, it soon became apparent that the extent to which the employer cooperated in the survey was an important determinant of the response rate among employees. Larger employers were therefore encouraged to indicate to employees that their help in completing survey questionnaires was desired by the employer. Where employers sent internal memoranda to employees requesting cooperation in the survey (either with the questionnaires or separately), considerably higher return rates were obtained.

At two major employers it was agreed to supply the employer with tabulations of data for their own employees. This proved to be a very effective inducement, as both employers sent out memoranda to employees and actively followed up on slow returns. (At one of the two employers, a children's hospital, a 100% return rate was achieved.)

Substitute Workplaces. Three substitute workplaces (two manufacturing plants and one retail establishment) were selected to compensate for the refusal to cooperate on the part of three very large employers in Alameda County. The substitutions were made in the same types of business and in the same zones as the refusals.

Short Questionnaires. Toward the end of the field work, short questionnaire forms (Figure A-10) were distributed to obtain information about workers who had refused or neglected to fill out regular survey questionnaires. This information was intended to provide a basis for estimating nonresponse error. Information was requested on the usual method used to get to work, and the respondent's sex, age, race, and education level. The response rate for the short questionnaire was much higher than that for the regular questionnaire partly because of the simplicity of the short questionnaire and partly because the short questionnaire could be (and often was) completed by the employer or someone other than the respondent.

Editing, Coding, and Data Processing

General Procedures. As questionnaires were collected by the field workers, the envelope containing each questionnaire was marked with an employer identification number and the zone number of the workplace location. The employer identification and zone numbers were later transferred to the questionnaire itself.

To ensure respondent anonymity, lists of employees used by employers to keep track of questionnaire distribution and collection were left with the employers. Once the envelopes in which questionnaires were returned (which sometimes bore employee identification) had been discarded, there was no way of identifying individual respondents from questionnaires (except, obviously, in the case of a one-worker workplace).

Questionnaires were consecutively numbered as they were received to permit control in data processing, but these numbers were not tied to any respondent identification.

In coding information from the questionnaires, coders concentrated on only one or two pages of the questionnaire at a time, so they could keep in mind the rules governing the particular questions they were coding. However, the questionnaires themselves were not separated by page, so the coder could refer to other parts of the questionnaire if necessary to interpret answers.

Codes for replies to questions were written across the bottom of the page on which the replies appeared. The codes were then typed onto forms using an optical character recognition (OCR) type and these data were transferred to magnetic tape using an optical scanner. After preliminary editing, the data were listed in a format easily interpreted by the coders, and data listings were proofread by comparing them with the replies on the questionnaires (not with the coder marks on the questionnaires). Thus, a single proofreading allowed both coding and typing accuracy to be checked.

Proofreader corrections were then entered onto the data tape, and a check was made that each code used was a permissible code. Then the data were converted into the format desired for the final data tape.

Coding and Editing Rules. The questionnaire consisted mainly of straightforward questions which allowed little room for misinterpretation. However, as in any survey using self-completion questionnaires, some apparently inconsistent responses were obtained.

Apparently inconsistent responses were investigated in an effort to determine what led the respondent to reply as he did, and what the "correct" responses should have been. When it was possible to do so,

the inconsistencies were corrected. When it was not possible to determine correct responses, apparent inconsistencies were left as reported by the respondent. Completely impossible answers (to questions requesting information to which the respondent must surely have known the correct answer) were changed to "no answer" if the correct answer could not be determined.

For example, respondents were asked on how many days per week each mode of travel was used to go to work. Some interpreted the question as asking about the number of trips to and from work. Where it was clear this was the case, the answer was edited. Where there was doubt about what the respondent had in mind, his answer was left unchanged. As another example, some respondents answered the question about bridge tolls in terms of cost per month rather than cost per day. Where it was clear this was the case, the figure given was edited to represent cost per day; where there was doubt, the figure given by the respondent was not changed.

Coding Zone of Residence. After all questionnaire responses had been edited (so that there was no longer need to keep questionnaires in numerical order), coding the zone of residence for each respondent was begun. Questionnaires were first sorted by county and city of residence. The cross street location for each address was then located on a zone map, and the zone was coded on the front of the questionnaire. Coding was conducted one city at a time to permit a coder to become familiar with streets and intersections within that city.

A high proportion of questionnaires provided identifiable residence locations, as can be seen from the following tabulation:

Questionnaires giving sufficient address detail to allow the resident zone to be identified positively	92%
Questionnaires giving residence addresses outside the five-county Bay Area	3%
Questionnaires giving only the city or county of residence	2%
Questionnaires giving no residence address information	3%
	100%

III. SURVEY RESPONSE AND WEIGHTING

Overall Response Rate

As already noted, a total of 1,382 workplaces, employing an estimated 18,700 workers, were originally listed as the survey sample. The term "workplace" as used here defines the space on a single floor occupied by one company, agency, or other organization dealt with as an independent unit in the conduct of the survey. For most workplaces, the estimated number of workers was the figure provided by the personnel director, manager, or other responsible person. In the few places that refused to cooperate even to the extent of providing this information, estimates were made on the basis of onsite observation.

Of the original sample, 93 workplaces were vacant at the time field workers returned to distribute questionnaires. (When the originally listed occupant had moved out and another occupant had taken over the premises, the new occupant was included in the sample.) The remaining 1,289 occupied workplaces (with 18,284 workers), formed the sample to which survey questionnaire distribution was attempted.

Employer cooperation at these 1,289 workplaces was as follows:

	Occupied Workplaces	Number of Workers	Average Number per Workplace
Workplaces where some employer cooperation was obtained (at least one questionnaire completed)	901 (70%)	14,381 (79%)	16.0
Workplaces where employer cooperation was not obtained	388 (30%)	3,903 (21%)	10.1
Total	1,289 (100%)	18,284 (100%)	14.2

The average number of workers per workplace among workplaces where no cooperation was obtained was smaller than the average for the sample as a whole. However, this does not mean that the resulting sample of completed questionnaires underrepresented small workplaces. Very small places (1, 2 or 3 workers) tended to produce either a 0% or 100% response, so there was a relatively low proportion of them in the set of workplaces where employer cooperation was obtained. On the other hand, among those employers who did cooperate, the employee response rate was higher from small employers than from large companies.

As noted earlier, three substitute workplaces were selected to compensate for the effect on the sample distribution of the failure of three large employers to cooperate. Including the questionnaires distributed at the substitute workplaces, 8,391 usable questionnaires were returned from a total of 14,381 questionnaires distributed at 901 workplaces. The overall response rate was thus 58%, an unusually high percentage for a self-completion survey questionnaire of this complexity.

Comparison of Respondent and Nonrespondent Characteristics

As noted in Chapter II, toward the end of the survey field work, short postcard-sized questionnaires were distributed to obtain information about workers who had not filled out the regular survey questionnaire. The short questionnaire requested information about ethnic category, age, sex, education, and usual mode for the journey to work.

The short "nonrespondent" questionnaire was completed for or by 819 workers in the survey sample who did not complete the regular survey questionnaire. (In some cases, the information about the nonrespondent was obtained from a person other than the nonrespondent himself, such as the personnel manager or a fellow worker, where the field worker was reasonably confident that the information would be accurate.)

For a subset of 97 workplaces (employing an estimated 1,031 workers) either long or short questionnaires were completed for virtually all workers:

Number of workers estimated before questionaires returned	1,010
Completed respondent (long) questionnaires	377
Completed nonrespondent (short) questionnaires	654
Total of completed long and short questionnaires	1,031

Data from these 1,031 questionnaires were considered to be the best available basis for estimating nonresponse bias in the survey. Weighting factors computed from these data are given at the end of the chapter. The characterisics of "respondents" and "nonrespondents" for the 97 workplaces (assuming 1,031 is the true total number of workers) are summarized in Table 4.

Education Level. As shown in Table 4, the response rate from persons who had attended college was more than twice as high as the response rate from those who had not. A higher response rate from better-educated people is usually the case in self-completion questionnaire surveys; the long and relatively complex questionnaire in this survey presumably accounted for the much lower response rate from less-educated people.

Sex. Table 4 shows a significantly higher response rate from women (44%) than from men (32%) for workers surveyed in the 97 workplaces.

A similar difference in response rate was obtained for the 1,289 workplaces in the survey as a whole. At the time of original sample selection, an estimate of the total number of male and female workers in each workplace was made. Later, when questionnaires were distributed to cooperating

Table 4

CHARACTERISTICS OF RESPONDENTS AND NONRESPONDENTS
(Data for 97 selected workplaces)

	Total Workers	Repondents[a]	Nonrespondents[b]	Response Rate
Education Level				
High School or Less	635	156	479	25%
Attended College	367	208	159	57
Sex				
Men	664	210	454	32%
Women	353	154	199	44
Age				
Age under 30	317	106	211	33%
30 - 49	464	154	310	33
50 or Older	182	90	92	49
Ethnic/Racial Category				
Nonwhite	313	89	224	28%
White	682	267	415	39
Usual Work Travel Method				
Walk or Bicycle	44	18	26	41%
Automobile	790	248	542	31
Walk, Bicycle, or Auto	834	266	568	32%
Bus	88	43	45	49%
Train	107	68	39	64
Bus or Train	195	111	84	57%
Total (97 Workplaces)	1,031	377	654	37%

a. Information obtained from completed full-length survey questionnaire.
b. Information obtained from short "nonresponse" survey questionnaire.

Source: BART Impact Program, 1977 Work Travel Survey.

employers these estimates were refined. Comparison of the total employment estimates with the number of returned questionnaires shows the following response rates:

	Total Workers	Respondents	Nonrespondents	Response Rate*
Men	10,560	3,964	6,596	38%
Women	7,724	3,860	3,864	50
No sex indicated	--	260		
Total (1,289 workplaces)	18,284	8,084	10,200	44%

*Including workplaces where no questionnaires were distributed, but excluding the three substitute workplaces.

Age. The data shown in Table 4 indicate a higher response rate from people over 50 years old than from people under 50 years old. However, there were relatively few people over 50 in the 97-workplace subsample, reducing the statistical reliability of the associated response rate estimate.

Ethnic/Racial Category. Because of the limited number of people in the 97-workplace subsample belonging to any individual ethnic group other than white, the only useful comparison is between white and all other races combined, as given in Table 4. The response rate among whites was higher than among nonwhites. This difference probably correlates with the difference in average education level between the two groups.

Usual Method of Travel to Work. The data given in Table 4 suggest that people who usually ride the bus or train to and from work had a higher response rate to the survey than did those who usually drive (or

walk or bicycle). The survey questionnaire probably appeared to many people to emphasize public transportation interests, so that people who used public transportation regularly might have been more motivated to cooperate in the survey.

Response Rates by Workplace Type

Workplace Location. The sample distribution and response rates for five major areas within the 88-zone work travel survey area (including the three substitute workplaces) were:

	Total Workers	Completed Questionnaires	Percent Response*
Contra Costa County	1,545	689	45%
Alameda County, non-CBD	6,783	2,800	41
Alameda County, CBD	2,457	1,303	53
San Francisco County, non-CBD	3,198	1,368	43
San Francisco County, CBD	4,301	2,231	52
Total (1,289 workplaces)	18,284	8,391	46%

*Including workplaces where no questionnaires were distributed, and including the three substitute workplaces.

In both San Francisco County and Alameda County there was a higher response in the central business districts. This correlated closely with the higher proportion of workers in the CBDs who had attended college.

Type of Business or Work Activity. Workplace locations were classified into 12 categories of business type, selected on the basis of frequency of occurrence in the sample and ease of classification from

available information. The sample distribution and response rates for the 12 categories (including the 3 substitute workplaces) are given in Table 5.

As shown, the variations in the overall response were wide. To a minor degree, these reflected differences in the kinds of workers employed by different businesses. But a more important source of variation was the extent to which different employers cooperated in distributing questionnaires and encouraging their employees to fill them out.

Some of the differences in the extent to which employers cooperated may reflect characteristics of the kinds of businesses involved (for example, persons in charge of large manufacturing operations may tend to be more concerned about the cost of employee work time used to fill out questionnaires than their counterparts in small businesses or in public agencies).

But much of the variation may also be due to chance. Within an individual type of business category the cooperation or lack of cooperation of people in charge of a few large workplaces can have a substantial effect on the overall response rate. For example, among the 68 manufacturing establishments, the proportion of employers who cooperated was 65% (44 of the 68), close to the 70% cooperation level for the sample as a whole. But it happened that five of the six largest establishments did not cooperate. The average number of workers in cooperating manufacturing workplaces was 33; in those not cooperating, it was 66. Had the managers of these five floors taken a different point of view toward the survey, the manufacturing category would not be below average.

Table 5

RESPONSE RATES BY TYPE OF BUSINESS OR WORK ACTIVITY

Type of Business	Number of Work Places	Total Workers	Completed Questionnaires[b]	Percent Response
Manufacturing	68	3,019	724	24%
Retail	326	2,840	1,331	47
Restaurants and Bars	87	564	234	41
Construction and Engineering	31	1,629	553	34
Financial Services	77	1,482	896	60
Other Services and Utilities	314	3,076	1,608	52
Professional Offices	90	462	254	55
Wholesale Trade	52	298	109	37
Hospitals	22	568	422	74
Schools	102	1,556	742	48
Other Public Employment	68	1,889	1,191	63
Other	52	901	327	36
Total All Workplaces Sampled[a]	1,289	18,284	8,391	46%

a. Includes workplaces where employer cooperation was not obtained, and where no questionnaires were distributed.
b. Includes questionnaires from the three substitute workplaces.

Source: BART Impact Program, 1977 Work Travel Survey.

Number of Employees. Differences in response rates as a function of the number of people employed at the workplace were relatively small:

Number of Workers at Workplace	Number of Workplaces	Total Workers	Completed Questionnaires	Percent Response*
1-3	521	1,034	551	53%
4-10	427	2,670	1,345	50
11-25	188	3,146	1,490	47
26 or more	153	11,434	5,005*	44
Total all workplaces	1,289	18,284	8,391	46%

*Including workplaces where no questionnaires were distributed, and including questionnaires from the three substitute workplaces.

Although this tabulation gives the appearance of decreasing response rate with increasing number of employees, the effect is not great, and to some extent could be the result of the selection of groupings.

Weighting Factors

Nonreponse Bias Weighting Factors. After the differential response rates for the various stratifications of the survey sample were analyzed (as summarized in this chapter), it was decided to compute differential weighting factors to compensate for nonresponse bias as a function of (1) whether the respondent usually rode public transit to work or not, (2) whether the respondent attended college or not, (3) whether the respondent was male or female, and (4) whether the respondent was white or nonwhite. These nonresponse weighting factors were calculated from detailed cross-tabulations of the data collected for the respondent sample and the total sample (respondents and nonrespondents together) at the 97 selected workplaces

(as summarized in Table 4). The resulting individual weighting factors are specified in Table 6. These differential weighting factors were used in all analyses in the remainder of this report.

Projection Rates. The overall projection ratio relating the 8,391 questionnaire responses to the actual number of workers in the surveyed population was derived as follows:

1. An interval of 9.024 was used in the initial selection of blocks for the sample, and the sample included every third floor on each selected block. Thus, the initial sampling ratio was 1:27.072, with each floor in a nonresidential block having this chance for selection.

2. Twenty-nine workplaces, accounting for 397 workers, were systematically selected and excluded from the sample drawn. (These workplaces were used for questionnaire pretesting.)

3. Thus, the chances of selection for the survey sample became:

$$\frac{18,284}{18,284 + 397} \times \frac{1}{27.072} = 0.03615$$

But 18,284 workers were selected, and only 8,391 questionnaires were completed. Therefore, the projection ratio became:

$$\frac{1}{0.03615} \times \frac{18,284}{8,391} = 60.3$$

Table 6

WEIGHTING FACTORS TO ACCOUNT FOR NONRESPONSE BIAS

Usual Work Travel Method	Education Level	Sex	Ethnic/Racial Category		
			White	Nonwhite	Unknown
Public Transit	High School	Male	0.8593	1.1832	0.9403
Public Transit	College	Male	0.4959	0.6828	0.5426
Public Transit	Unknown	Male	0.6163	0.8486	0.6744
Public Transit	High School	Female	1.0615	1.4615	1.1615
Public Transit	College	Female	0.5347	0.7362	0.5851
Public Transit	Unknown	Female	0.8146	1.1215	0.8913
Public Transit	High School	Unknown	0.9702	1.3358	1.0616
Public Transit	College	Unknown	0.5014	0.6903	0.5486
Public Transit	Unknown	Unknown	0.6606	0.9095	0.7228
Other Methods	High School	Male	2.0259	2.7894	2.2168
Other Methods	College	Male	0.5975	0.8227	0.6538
Other Methods	Unknown	Male	1.1767	1.6202	1.2876
Other Methods	High School	Female	0.8546	1.1766	0.9351
Other Methods	College	Female	0.6465	0.8901	0.7074
Other Methods	Unknown	Female	0.7532	1.0371	0.8242
Other Methods	High School	Unknown	1.4570	2.0061	1.5943
Other Methods	College	Unknown	0.6162	0.8483	0.6742
Other Methods	Unknown	Unknown	0.9887	1.3614	1.0819

Source: BART Impact Program, 1977 Work Travel Survey.

IV. SURVEY POPULATION CHARACTERISTICS

The origins, destinations, and modes of travel work trips are summarized in this chapter. (More detailed distributions by origin-to-destination corridor and by mode are given in Chapter V). Also described are socioeconomic and job characteristics of the surveyed work travelers, stratified according to their workplace areas (San Francisco CBD, Oakland CBD, and non-CBD workplaces), and their usual mode of travel to and from work.

In this chapter (and in the remainder of the report except where noted otherwise), the following terms are used to describe travel modes analyzed:

Term	Principal Travel Mode
BART	BART train
Bus	Bus or streetcar
Drive alone	Drive alone or with a family member in an automobile, truck, or motorcycle
Carpool	Carpool (with other than a family member) in an automobile, truck, or motorcycle
Automobile	Drive alone or carpool in an automobile, truck, or motorcycle
Walk	Walk all the way
Other	Other modes (primarily Southern Pacific train, ferryboat, taxi or bicycle)

The usual (or first choice) mode is the one given by survey respondents as the principal mode used most often in a typical week.

Distribution of Journey-to-Work Trips

As already noted, the work travel survey sampled 8,400 workers who make trips to workplaces in the survey area.* A total of 506,000 daily work trips are represented by this sample, of which an estimated 66,000 daily trips to work (13%) are made by BART.**

Origin Distribution. Table 7 summarizes the survey trip origins by county of the 506,000 trips by all modes, and the 66,000 trips by BART. Of all trips to workplaces in the survey area, 86% are from the three BART District Counties of San Francisco, Alameda, and Contra Costa. Of BART trips, 85% are from these three counties. San Mateo County accounts for 8% of all trip origins and 13% of BART trip origins.

Table 8 summarizes the survey trip origins by the residence areas defined in Figure 2 and Table 2. Of the total of 506,000 trips by all modes, 59% or 298,200 daily trips to work are from residences in the five-corridor primary BART service area. Of the 66,000 BART trips, 70% or 46,100 are from residences in the primary BART service area.

Destination Distribution. Table 9 shows the distribution of survey trips by the workplace areas defined in Figure 1 and Table 1. Of the 506,000 daily work trips covered in the survey, 47% are made to workplaces in the central business districts (CBDs) of San Francisco (35%) or Oakland (12%).

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*In the remainder of the report text, estimated numbers of trips are given to the nearest hundred.

**The 66,000 trips shown by the survey as the number usually made by BART is higher than the actual number of round trip work trips made by BART on a typical day (about 50,000 at the time of the survey). The reason is that, on any given day, many travelers who usually ride BART decide instead to drive or use some other means of transport to get to or from work (as discussed in Chapter V).

Table 7

DISTRIBUTION OF SURVEY TRIP ORIGINS BY COUNTY

County of Residence	Work Trips by All Modes		Work Trips by BART	
	Number	Percent	Number	Percent
San Francisco County				
Within BART Service Area	66,600	13.5%	10,300	16.3%
Outside BART Service Area	47,600	9.7	2,900	4.5
Total	114,200	23.2%	13,200	20.8%
Alameda County				
Within BART Service Area	168,100	34.1%	20,700	32.8%
Outside BART Service Area	55,600	11.3	4,800	7.6
Total	223,700	45.4%	25,500	40.4%
Contra Costa County				
Within BART Service Area	58,300	11.8%	10,900	17.2%
Outside BART Service Area	28,800	5.9	4,400	6.9
Total	87,100	17.7%	15,300	24.1%
San Mateo County				
Within BART Service Area	15,000	3.0%	4,500	7.1%
Outside BART Service Area	23,300	4.8	3,600	5.6
Total	38,300	7.8%	8,100	12.7%
Marin County	14,900	3.0%	200	0.2%
Napa County	400	0.1	100	0.1
Sonoma County	3,600	0.7	200	0.3
Santa Clara County	5,900	1.2	600	1.0
Other Areas	4,400	0.9	300	0.4
Missing Values	13,500	--	2,500	--
Total Survey	506,000	100.0%	66,000	100.0%
Total Within BART Service Area[a]	308,000	60.9%	46,400	70.3%
Total Outside BART Service Area[b]	198,000	39.1%	19,600	29.7%

a. Missing values for origin home traffic zones account for the small differences between the Within BART Service Area totals given in Table 8 and the totals given here.

b. Includes missing values.

Source: BART Impact Program, 1977 Work Travel Survey.

Table 8

DISTRIBUTION OF SURVEY TRIP ORIGINS BY AREA

Area of Residence	Work Trips by All Modes[b] Number	Percent	Work Trips by BART Number	Percent
Daly City Corridor	81,100	16.0%	14,800	22.4%
Oakland Corridor	39,300	7.8	4,400	6.7
Richmond Corridor	36,200	7.2	4,500	6.8
Concord Corridor	40,600	8.0	9,000	13.6
Fremont Corridor	101,000	20.0	13,400	20.3
Subtotal All Corridors[a] (Primary BART Service Area)	298,200	59.0	46,100	69.8
BART Express Bus Area	27,300	5.4	3,000	4.6
Other Areas	180,300	35.6	16,900	25.6
Total All Origins	506,000	100.0%	66,000	100.0%

a. Missing values for origin home traffic zones account for the small differences between the Within BART Service Area totals given in Table 7 and the totals given here.

b. For sample size see Appendix D.

Source: BART Impact Program, 1977 Work Travel Survey.

Table 9

DISTRIBUTION OF SURVEY TRIP DESTINATIONS BY AREA

Area of Workplace	Work Trips by All Modes[a] Number	Percent	Work Trips by BART Number	Percent
San Francisco CBD	177,700	35.1%	30,100	45.5%
Oakland CBD	61,000	12.1	15,100	22.9
Subtotal CBD Destinations	238,800	47.2	45,200	68.4
San Francisco Other	27,300	5.4	2,500	3.9
Oakland Other	39,100	7.7	2.800	4.3
Richmond Line	40,300	8.0	4,700	7.1
Concord Line	34,000	6.7	1,800	2.7
Fremont Line	126,500	25.0	9,000	13.6
Subtotal Non-CBD Destinations	267,200	52.8	20,800	31.6
Total All Desitnations	506,000	100.0%	66,000	100.0%

a. For sample size see Appendix D.

Source: BART Impact Program, 1977 Work Travel Survey.

Mode Distribution. Table 10 summarizes the distribution of survey trips by usual mode of travel. Automobile accounts for 61% of all survey trips (53% drive alone, 8% carpool), bus accounts for 17%, BART for 13%, and walking for 6%.

Worker Characteristics

Tables 11 and 12 summarize data on the occupations and other socioeconomic characteristics of survey respondents according to (1) their workplace area, and (2) their usual mode of travel to work, respectively.

Workers in the San Francisco and Oakland CBDs are mainly office workers in the professional, managerial, and clerical occupation categories. More workers in the non-CBD areas are craftsmen, operatives, and laborers. Clerical workers form the largest single occupational group of survey respondents and constitute the largest group of users of all modes. The occupation distribution among BART riders generally matches the distribution among the total sample, although BART carries proportionately more clerical workers than are in the total sample. The high percentage of clerical workers using BART (and bus) reflects the higher shares of transit work trips to the CBDs.

The relatively high percentage of females working in the CBDs is noteworthy; it correlates with the higher female worker use of BART and bus. CBD workers are also typically younger than non-CBD workers. The two CBD areas exhibit significantly larger percentages of college-educated workers than do the non-CBD areas; a significant proportion of workers in other areas are not high school graduates. The distribution of workers by education is broadly similar for all modes of travel.

Respondents working in the two CBDs are typically more affluent than those employed in other areas, though less so than might perhaps be expected. Of survey respondents working in the San Francisco CBD, 40% enjoy an average

Table 10

DISTRIBUTION OF SURVEY TRIPS BY USUAL TRAVEL MODE

Usual Travel Mode	All Work Trips Surveyed	
	Number	Percent
Drive Alone	267,300	52.8%
Carpool	39,300	7.8
Subtotal (Automobile)	306,600	60.6
BART	66,000	13.1
Bus	87,800	17.3
Subtotal (BART or Bus)	153,800	30.4
Southern Pacific Train	4,600	0.9
Walk	30,000	5.9
Other Modes	11,000	2.2
Subtotal (Train, Walk or Other)	45,600	9.0
Total All Modes	506,000	100.0%

Source: BART Impact Program, 1977 Work Travel Survey.

Table 11

WORKER CHARACTERISTICS: CBD AND NON-CBD WORKPLACE AREAS

Worker Characteristic	Workplace Area: San Francisco CBD	Oakland CBD	Non-CBD Areas	Total All Areas
Occupation				
Professional and Technical	14.0%	19.3%	18.8%	17.0%
Managers and Officials	15.3	19.2	10.8	13.5
Sales Workers	4.8	8.2	4.9	5.3
Clerical Workers	45.9	40.6	22.1	33.0
Craftsmen and Foremen	4.5	3.2	10.3	7.3
Operatives	2.6	3.5	8.9	6.3
Service Workers	10.0	3.6	9.0	8.7
Laborers	1.6	1.7	14.1	7.9
Others	1.3	0.7	1.1	1.0
	100.0%	100.0%	100.0%	100.0%
Sex				
Male	46.2%	44.0%	62.2%	54.2%
Female	53.8	56.0	37.8	45.8
	100.0%	100.0%	100.0%	100.0%
Age				
Under 25	16.5%	14.2%	14.2%	15.0%
25 to 34	36.0	30.7	27.7	31.1
35 to 44	18.5	17.7	20.2	19.3
45 to 54	17.4	17.6	21.7	19.6
55 and over	11.6	19.8	16.2	15.0
	100.0%	100.0%	100.0%	100.0%
Average (years)	36.8	39.5	39.3	38.4
Education				
Less than High School	6.5%	4.0%	14.2%	10.2%
High School Graduate	32.9	24.7	37.3	34.1
Some College	31.8	34.6	26.2	29.3
4-year College Graduate	13.4	18.3	7.6	11.0
More than 4 Years' College	15.4	18.4	14.7	15.4
	100.0%	100.0%	100.0%	100.0%
Population Represented	177,700	61,100	267,200	506,000

Table 11 (Continued)

Worker Characteristic	Workplace Area: San Francisco CBD	Oakland CBD	Non-CBD Areas	Total All Areas
Annual Family Income				
Under $5,000	3.0%	3.2%	4.7%	3.9%
$5,000 to $9,999	21.2	15.9	14.0	16.8
$10,000 to $14,999	21.5	18.8	24.1	22.5
$15,000 to $19,999	14.3	14.8	18.5	16.5
$20,000 to $49,000	36.2	43.2	36.0	37.0
$50,000 or more	3.8	4.1	2.7	3.3
	100.0%	100.0%	100.0%	100.0%
Average	$21,500	$23,461	$21,485	$21,755
Ethnic/Racial Category				
White	55.2%	69.4%	64.9%	61.9%
Black	8.0	14.7	14.4	11.8
Spanish-American	8.5	4.1	11.2	9.4
Asian or Pacific Islander	26.1	9.3	7.5	14.8
Other	2.2	2.5	2.0	2.1
	100.0%	100.0%	100.0%	100.0%
Home Ownership				
Own home	26.1%	34.3%	35.3%	31.8%
Rent home	73.9	65.7	64.7	68.2
	100.0%	100.0%	100.0%	100.0%
Years Resided at Present Location				
Less than 1 year	27.3%	24.7%	22.3%	24.3%
1 to 2 years	25.1	23.5	18.9	21.6
3 to 4 years	13.8	13.9	12.2	13.0
5 to 10 years	16.2	15.6	17.7	16.9
Over 10 years	17.6	22.3	28.9	24.2
	100.0%	100.0%	100.0%	100.0%
Average (years)	5.8	6.6	8.0	7.0
Population Represented	177,700	61,100	267,200	506,000

Table 11 (Continued)

Worker Characteristic	Workplace Area: San Francisco CBD	Oakland CBD	Non-CBD Areas	Total All Areas
Persons in Household				
1	17.1%	18.6%	11.8%	14.6%
2	32.4	33.4	31.6	32.1
3	18.0	18.8	20.0	19.1
4	15.4	16.2	19.1	17.4
5	9.4	7.0	9.4	9.1
6 or more	7.7	6.0	8.1	7.7
	100.0%	100.0%	100.0%	100.0%
Average	2.95	2.82	3.13	3.02
Automobiles Available in Household				
None	11.9%	6.9%	4.1%	7.3%
1	42.1	36.6	29.0	34.6
2	33.5	41.5	45.3	40.6
3 or more	12.5	15.0	21.6	17.5
	100.0%	100.0%	100.0%	100.0%
Average	1.5	1.7	1.9	1.8
Population Represented	177,700	61,100	267,200	506,000

Source: BART Impact Program, 1977 Work Travel Survey.

Table 12

WORKER CHARACTERISTICS: USUAL MODE OF TRAVEL TO WORK

Worker Characteristic	Usual Mode of Travel to Work						
	BART	Bus	Drive Alone	Carpool	Walk	Other	Total All Modes
Occupation							
Professional and Technical	15.4%	14.4%	18.2%	18.3%	12.3%	24.8%	17.0%
Managers and Officials	13.4	10.4	14.8	13.5	10.0	17.5	13.5
Sales Workers	5.2	3.2	6.5	2.6	4.2	4.5	5.3
Clerical Workers	41.4	51.9	25.1	38.7	24.3	28.8	33.0
Craftsmen and Foremen	5.0	2.9	9.3	8.8	6.3	5.6	7.3
Operatives	6.1	3.8	7.7	1.7	8.3	5.1	6.3
Service Workers	7.2	9.6	7.9	6.0	19.8	6.7	8.7
Laborers	5.2	2.9	9.8	8.7	12.6	5.0	7.9
Others	1.1	0.9	0.7	1.7	2.2	2.0	1.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Sex							
Male	42.5%	34.9%	62.2%	54.0%	59.5%	65.1%	54.2%
Female	57.5	65.1	37.8	46.0	40.5	34.9	45.8
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Age							
Under 25	18.1%	19.3%	13.0%	13.1%	20.7%	17.1%	15.4%
25 to 34	31.0	33.8	29.7	34.8	26.3	40.4	31.1
35 to 44	20.9	17.2	20.0	20.3	12.5	20.0	19.2
45 to 54	15.6	15.7	21.6	17.5	25.4	13.7	19.5
55 and over	14.4	14.1	15.8	14.3	15.1	8.8	14.8
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average (years)	37.4	33.1	38.3	37.9	38.5	35.2	38.4
Education							
Less than High School	8.0%	7.5%	10.7%	9.3%	18.7%	6.8%	10.2%
High School Graduate	33.3	32.1	35.1	34.4	38.1	28.0	34.2
Some College	32.1	32.2	28.4	29.3	22.9	30.6	29.3
4-Year College Graduate	11.8	12.7	10.1	13.0	8.5	14.1	11.0
More than 4-Years' College	14.8	15.5	15.7	14.0	11.8	20.5	15.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Population Represented	66,000	87,800	267,300	39,300	30,000	15,600	506,000

Table 12 (Continued)

Worker Characteristic	Usual Mode of Travel to Work						
	BART	Bus	Drive Alone	Carpool	Walk	Other	Total All Modes
Annual Family Income							
Under $5,000	5.5%	5.0%	2.6%	2.6%	11.2%	4.9%	3.9%
$5,000 to $9,999	18.2	28.7	11.2	11.7	37.3	13.8	16.8
$10,000 to $14,999	21.8	23.8	22.4	21.7	21.3	20.4	22.5
$15,000 to $19,999	14.7	14.3	17.7	20.1	10.8	17.0	16.5
$20,000 to $49,999	37.6	26.2	41.8	41.6	17.9	38.7	37.0
$50,000 or more	2.2	2.0	4.3	2.3	1.5	5.2	3.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average	$21,205	$18,030	$23,641	$22,927	$14,916	$22,948	$21,755
Ethnic/Racial Category							
White	56.3%	54.6%	66.9%	60.2%	50.6%	72.3%	62.0%
Black	13.4	10.8	12.4	9.3	10.2	8.0	11.8
Spanish-American	12.6	8.1	8.6	11.7	10.2	8.7	9.3
Asian or Pacific Islander	15.4	24.5	10.1	17.0	26.3	8.7	14.8
Other	2.3	2.0	2.0	1.8	2.7	2.3	2.1
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Automobiles Available in Household							
None	7.6%	21.6%	0.8%	2.2%	29.6%	9.6%	7.2%
1	38.1	47.1	28.3	35.5	43.5	35.8	34.4
2	39.8	24.2	48.0	44.2	20.1	37.8	40.7
3 or more	14.5	7.1	22.9	18.1	6.8	16.8	17.7
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average	1.7	1.2	2.0	1.8	1.1	1.7	1.8
Population Represented	66,000	87,800	267,300	39,300	30,000	15,600	506,000

Source: BART Impact Program, 1977 Work Travel Survey.

family income of $20,000 or more per year; for workers in the Oakland CBD the figure is 47%; and for non-CBD workers the figure is 39%. People who walk to work have lower incomes on average than workers using other modes: 49% of walkers come from families with an annual income of less than $10,000 (compared with only 14% among automobile commuters).

In total, 38% of workers surveyed are nonwhite; 44% of those whose first choice mode is BART are nonwhite. Asians make up 26% of workers in the San Francisco CBD compared with 9% of Oakland CBD workers and 7% of non-CBD workers.

Work travelers employed in the two central business districts have typically lived at their present residence for a shorter period than respondents working in non-CBD areas. This may largely reflect the generally lower age of CBD workers. As shown later (in Table 13), job mobility is also greater among workers in the CBDs (particularly in San Francisco) than among non-CBD workers.

Among survey respondents, 68% rent their homes, and 32% own them. The percentage of respondents owning their own homes is lowest (26%) for those employed in the San Francisco CBD. Again, this may be largely explained by the higher proportion of young people working in the San Francisco CBD compared with the Oakland CBD or non-CBD areas.

Automobile ownership per household is highest for the households of work travelers employed in non-CBD areas. This is consistent with the larger household size of workers employed in the non-CBD areas, and with the data presented in Chapter V (Table 15) which show a much higher percentage of automobile travel to non-CBD workplaces than to CBD workplaces. As might be expected, the number of automobiles per household is highest for households where the worker travels to and from work by automobile. Drive alone worker households own 2.0 vehicles on average.

Job Characteristics

Tables 13 and 14 summarize data on job characteristics of survey respondents according to their workplace area and travel mode, respectively.

Included in Table 13 are the reasons given by respondents as the most important in their decision to accept their present employment. Job-related reasons are dominant in influencing job selection decisions. In all areas considered, "other job-related" reasons and "transferred" together constitute the most important reason for job acceptance of fully 50% of respondents, with "no choice" accounting for the next largest share (between 21% for Oakland CBD workers, and 29% for San Francisco CBD workers). Proximity to public transportation facilities is listed as the most important reason for job acceptance by only 1% of the sample.

However, information shown in Table 13 refers only to the most important reason cited by respondents as influencing the decision to accept their present job. Among secondary reasons given, "convenient to home" is mentioned most frequently (27% of responses). "Convenient to public transportation" is mentioned next most often (17% of responses). Thus, while job and career factors are primarily responsible for motivating respondents to accept a job, locational factors are evidently important at a secondary level.

The average period spent by respondents in their present employment location is highest for work travelers employed in non-CBD work zones 7 years) and lowest for San Francisco CBD employees (5 years). The table shows generally high job mobility among workers surveyed. Almost half the workers surveyed have been employed at their present location for 2 years or less. In the San Francisco CBD, almost 30% of work travelers surveyed have worked at their present location for 1 year or less, and only 12% have worked in the same place for more than 10 years. This contrasts with the Oakland CBD and non-CBD work areas where, respectively, 20% and 21% of workers have worked in the same place for more than 10 years.

Table 13

JOB CHARACTERISTICS: CBD AND NON-CBD WORKPLACE AREAS

Job Characteristic	Workplace Area: San Francisco CBD	Oakland CBD	Non-CBD Areas	Total All Areas
Principal Reason for Job Acceptance				
No Choice	29.4%	20.9%	27.9%	27.6%
Transferred	11.4	10.6	6.7	8.8
Other Job-related	41.4	49.7	46.3	45.0
Bay Area Location	4.9	4.1	3.5	4.1
Downtown Location	4.5	7.2	10.3	7.9
Convenient to Home	2.4	1.2	0.3	1.1
Convenient to Public Transportation	1.3	1.5	0.2	0.7
Other	4.7	4.8	4.8	4.8
	100.0%	100.0%	100.0%	100.0%
Years Worked at Present Location				
Less than 1	29.4%	23.5%	23.2%	25.4%
1 to 2	26.6	23.4	21.0	23.3
3 to 4	15.4	15.7	14.3	14.9
5 to 10	16.5	17.4	20.4	18.7
Over 10	12.1	20.0	21.1	17.7
	100.0%	100.0%	100.0%	100.0%
Average (years)	5.0	6.5	6.9	6.2
Days per Week Usually Worked				
1 to 3	2.4%	3.6%	3.6%	3.2%
4	1.8	1.6	3.6	2.7
5	86.0	85.0	80.0	82.7
6	7.9	8.5	8.8	8.5
7	1.9	1.3	4.0	2.9
	100.0%	100.0%	100.0%	100.0%
Average (days)	5.03	5.01	5.03	5.03
Typical Start Work Time				
Before 7:00 a.m.	10.2%	6.2%	18.3%	14.0%
7:00 a.m. to 9:00 a.m.	76.4	84.6	68.4	73.2
After 9:00 a.m.	13.4	9.2	13.3	12.8
	100.0%	100.0%	100.0%	100.0%
6:00 a.m. to 9:00 a.m.	86.6%	90.8%	86.7%	87.2%
7:30 a.m. to 8:30 a.m.	53.9%	63.2%	50.7%	53.4%
Population Represented	177,700	61,100	267,200	506,000

Table 13 (Continued)

Job Characteristic	Workplace Area: San Francisco CBD	Oakland CBD	Non-CBD Areas	Total All Areas
Typical Finish Work Time				
Before 2:00 p.m.	3.4%	3.2%	6.9%	5.2%
2:01 p.m. to 4:00 p.m.	20.8	9.3	23.7	21.0
4:01 p.m. to 5:00 p.m.	50.2	50.8	48.1	49.1
5:01 p.m. to 6:00 p.m.	19.0	32.1	13.7	17.8
After 6:00 p.m.	6.6	4.6	7.6	6.9
	100.0%	100.0%	100.0%	100.0%
Importance of Punctual Arrival at Work				
Very Important	71.8%	66.3%	75.5%	73.1%
Somewhat Important	22.4	25.5	17.1	20.0
Not Important	5.8	8.2	7.4	6.9
	100.0%	100.0%	100.0%	100.0%
Car Usually Needed for Work				
Yes	25.9%	33.4%	52.7%	41.0%
No	74.1	66.6	47.3	59.0
	100.0%	100.0%	100.0%	100.0%
Population Represented [a]	177,700	61,100	267,200	506,000

a. See Appendix D for sample size by workplace area.

Source: BART Impact Program, 1977 Work Travel Survey.

Table 14

JOB CHARACTERISTICS: USUAL MODE OF TRAVEL TO WORK

Job Characteristic	Usual Mode of Travel to Work: BART	Bus	Drive Alone	Carpool	Walk	Other	Total All Modes
Days per week usually worked							
1 to 3	3.0%	2.5%	3.3%	3.1%	4.1%	5.7%	3.2%
4	1.6	1.9	3.1	2.1	4.6	3.5	2.7
5	86.2	86.4	81.8	86.3	71.2	77.7	82.7
6	7.0	7.5	8.3	7.2	15.7	9.1	8.5
7	2.2	1.7	3.5	1.3	4.4	4.0	2.9
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average (days)	5.01	5.04	5.00	5.02	5.09	4.99	5.03
Typical Start Work Time							
Before 7:00 a.m.	12.1%	9.2%	16.7%	14.1%	12.4%	10.7%	14.1%
7:00 a.m. to 9:00 a.m.	75.5	78.0	71.4	79.9	59.7	73.0	72.8
After 9:00 a.m.	12.4	12.8	11.9	6.0	27.0	16.3	13.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
6:00 a.m. to 9:00 a.m.	87.3%	86.8%	86.3%	93.5%	71.8%	83.2%	87.2%
7:30 a.m. to 8:30 a.m.	57.0%	57.7%	51.8%	58.5%	41.0%	52.9%	53.4%
Typical Finish Work Time							
Before 2:00 p.m.	3.2%	3.4%	6.3%	3.2%	7.7%	7.4%	5.2%
2:01 p.m. to 4:00 p.m.	19.7	16.8	22.5	24.4	18.6	17.2	20.9
4:01 p.m. to 5:00 p.m.	51.7	54.0	46.2	56.0	41.8	47.8	48.8
5:01 p.m. to 6:00 p.m.	19.2	19.4	17.4	15.1	16.4	19.2	17.8
After 6:00 p.m.	6.2	6.4	7.6	1.3	15.5	8.4	7.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Importance of Punctual Arrival at Work							
Very Important	73.5%	75.1%	73.9%	74.4%	62.4%	65.0%	73.1%
Somewhat Important	20.9	21.8	18.9	19.4	20.9	24.4	20.0
Not Important	5.6	3.1	7.2	6.2	16.7	10.6	6.9
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Population Represented	66,000	87,800	267,300	39,300	30,000	15,600	506,000

For all workplace areas and principal travel modes used, the average number of days worked per week by the surveyed workers is very close to 5 days. Of the total sample, 83% of respondents work 5 days per week, 11% work more than 5 days, and 6% work less than 5 days. The distribution of work days per week for respondents classified by principal mode of travel to work does not display any startling variations among the modes.

Tables 13 and 14 illustrate the generally early work start times in the survey area. Nearly 60% of all workers report a start time of 8:00 a.m. or earlier. The table also shows that travel to the San Francisco CBD is rather less "peaked" than Oakland CBD travel. Of Oakland CBD work travelers, 63% start work between 7:30 a.m. and 8:30 a.m.; of San Francisco CBD work travelers, only 54% start between 7:30 a.m. and 8:30 a.m. Commuter travel to San Francisco is presumably spread over a longer period to avoid the more severe peak period congestion into downtown San Francisco. The variety of jobs in downtown San Francisco also probably accounts for some of the spread of start times. For example, financial district employees tend to start work earlier in the peak while retail sales workers begin somewhat later.

Punctual arrival at work is rated "very important," by rather fewer respondents in the CBD areas than in non-CBD areas. BART users are little different from bus and automobile commuters in their ratings of the importance of not being late. This is interesting in that, given BART's widespread reputation for unreliability (see Chapter VI), it might be expected that proportionately fewer people for whom it is very important not to be late for work would ride BART than would use other modes. This does not seem to be the case.

Work finish times are slightly more dispersed than are work start times. The busiest finish work hour is 4:00 p.m. to 5:00 p.m. during which about half the sample finish work for the day in each of the three areas. San Francisco CBD workers again show a more dispersed pattern of work finish times than do Oakland CBD workers. San Francisco workers also typically finish work earlier, with 21% of San Francisco CBD workers indicating that they quit work between 2:00 p.m. and 4:00 p.m., compared with only 9% of Oakland CBD workers.

V. JOURNEY-TO-WORK MODE CHOICES

BART's share of travel in the various travel markets and corridors covered by the work travel survey is analyzed in this chapter. The likely without-BART mode distribution of trips is also estimated by analyzing the alternative travel modes of BART riders included in the survey.

Distribution of Origin-Destination Work Trips by Mode

As shown in Table 9, nearly half the 506,000 daily work trips covered in the survey are to destinations in the San Francisco CBD (177,700 trips, 35% of the survey total) or the Oakland CBD (61,100 trips, 12%). Workplaces in the industrial areas of San Leandro and other parts of the BART Fremont Line survey area are also the destinations for a large number of surveyed work trips (126,500 trips, 25%). The remainder (140,700 trips, 28%) are to workplace destinations in non-CBD areas of San Francisco and Oakland and to areas served by the Richmond and Concord Lines. For trips to work beginning in the five corridors of the primary BART service area, the largest origin-to-destination work trip volumes are the 70,700 trips between origins and destinations on the Fremont Line and the 64,100 trips from the Daly City Corridor to the San Francisco CBD.

Table 15 shows journey-to-work mode shares by origin-to-destination travel corridor for BART, bus, automobile, and other modes. As detailed in Table 10, BART's share of total surveyed trips is 13%, compared with bus, 17%; automobile, 61%; and other modes, 9% (including walk trips, 6%). Considering only trips to work that begin within the five-corridor primary BART service area, the shares are: BART 15%; bus, 14%; automobile, 59%; and other modes, 12% (including walk trips, 9%). Considering only trips made by BART, bus, or automobile, the shares are BART 18%, bus 16%, and automobile 66%.

Table 15

MODAL DISTRIBUTION OF WORK TRIPS BY ORIGIN-DESTINATION CORRIDOR

Origin Residence Area	Usual Mode to Work	Destination Workplace Area: San Francisco CBD	San Francisco Other	Oakland CBD	Oakland Other	Richmond Line	Concord Line	Fremont Line	Total All Destinations
Daly City Corridor	BART	19.9%	7.7%	48.2%	13.4%				18.2%
	Bus	29.9	16.8	--	16.3	*	*	*	26.7
	Auto	32.3	46.1	51.8	70.2				36.2
	Other	17.8	29.4	--	--				18.8
Oakland Corridor	BART	21.1%		8.2%	6.6%	9.4%		15.1%	11.3%
	Bus	39.2	*	27.3	12.6	9.5	*	8.4	19.4
	Auto	39.7		42.4	63.3	68.6		73.5	56.8
	Other	--		22.1	17.4	12.6		3.1	12.6
Richmond Corridor	BART	13.3%		29.2%	3.3%	10.6%		11.3%	12.4%
	Bus	53.2	*	16.1	5.1	6.8	*	2.1	13.3
	Auto	33.5		53.8	81.9	54.1		86.6	59.1
	Other	--		0.9	9.7	28.6		--	15.2
Concord Corridor	BART	53.0%		41.4%	7.1%	11.8%	5.6%	11.2%	22.2%
	Bus	10.9	*	--	1.4	--	2.0	--	2.9
	Auto	36.1		54.4	87.2	82.6	80.7	83.6	68.4
	Other	--		4.2	4.2	5.5	11.6	5.2	6.5
Fremont Corridor	BART	32.7%		32.4%	14.0%	23.8%		7.0%	13.3%
	Bus	25.8	*	20.8	3.3	2.1	*	3.4	7.2
	Auto	40.2		41.7	82.0	72.2		81.5	73.0
	Other	1.3		5.1	0.7	1.9		8.1	6.5
Subtotal All Corridors (Primary BART Service Area)	BART	23.4%	11.3%	26.6%	8.2%	11.7%	6.6%	8.2%	15.5%
	Bus	29.6	16.9	17.8	6.9	6.4	1.8	3.8	14.3
	Auto	33.7	46.9	46.0	76.4	60.7	81.2	80.9	58.6
	Other	13.3	24.9	9.6	8.5	21.2	10.4	7.1	11.6
BART Express Bus Area	BART	38.2%		21.8%	--%	7.5%	2.6%	8.2%	11.2%
	Bus	18.6	*	2.1	1.7	1.7	3.0	--	3.9
	Auto	42.0		76.1	98.3	90.7	93.2	91.8	84.1
	Other	1.2		--	--	--	1.1	--	0.8
Other Areas	BART	9.7%	6.7%	21.2%	6.3%	12.8%	5.7%	4.4%	9.4%
	Bus	41.4	17.0	16.7	8.0	7.2	--	4.2	24.5
	Auto	41.5	70.9	61.1	83.4	71.7	91.0	86.3	60.4
	Other	7.4	5.3	1.0	2.2	8.2	3.3	5.1	5.8
Total All Origins	BART	16.9%	9.4%	24.7%	7.2%	11.6%	5.3%	7.1%	13.1%
	Bus	35.2	16.8	16.4	7.0	6.2	1.8	3.7	17.3
	Auto	37.8	57.1	52.4	79.7	66.1	86.5	82.9	60.6
	Other	10.1	16.7	6.5	6.2	16.1	6.4	6.3	9.0
Number of Trips		177,700	27,300	61,100	39,100	40,300	34,000	126,500	506,000
Percent of Trips		35%	5%	12%	8%	8%	7%	25%	100%

Note: Percentages shown in each origin-destination block are the percentages of origin-destination work trips by all modes made by (1) BART, (2) bus or streetcar, (3) automobile, truck, or motorcycle, and (4) other modes. For example, the block of percentages in the top left corner shows that, of the total work trips made from residences in the Daly City Corridor to workplaces in the San Francisco CBD, 19.9% are made by BART, 29.9% are made by bus (or streetcar), 32.3% are made by automobile (or truck or motorcycle), and 17.8% are made by other modes.
Weighted and unweighted sample sizes for the cells in this table are shown in Appendix D.

*Indicates that less than 1.000 daily trips are made by all modes combined.

Source: BART Impact Program, 1977 Work Travel Survey.

Table 15 shows that, within the work travel survey total, BART's share of trips to the San Francisco and Oakland CBDs is much higher than to non-CBD workplace areas. BART's share of trips to workplaces in the Oakland CBD is 25%, and its share of trips to workplaces in the San Francisco CBD is 17%. Considering only trips made from origins within the five-corridor primary BART service area, BART's share of CBD trips is higher still; 27% of trips to the Oakland CBD and 23% of trips to the San Francisco CBD are made by BART.

Table 15 also shows that BART's trip shares are greatest for long trips, such as those from the Concord Corridor to the San Francisco CBD (where BART's share is 53%); from the Daly City Corridor to the Oakland CBD (49%); from the Concord Corridor to the Oakland CBD (41%); from the Fremont Corridor to the San Francisco CBD (33%); and from the Fremont Corridor to the Oakland CBD (32%). BART's share is smallest for short within-corridor trips, such as those from the Daly City Corridor to non-CBD San Francisco workplaces (8%); from the Oakland Corridor to the Oakland CBD (8%); and from the Oakland Corridor to non-CBD Oakland workplaces (7%).

San Francisco CBD Trips. Of work trips from the Daly City Corridor to the San Francisco CBD, 50% are made by public transit (20% BART, 30% bus). Another 15% of workers usually walk to work. In the East Bay, Table 15 shows marked differences among the mode distributions for travel to the San Francisco CBD from the various corridors. The BART-plus-bus transit share is not much different among the four East Bay-to-San Francisco CBD corridors, but the split between BART and bus varies a great deal.

For trips from the Concord Corridor to the San Francisco CBD, transit travel is mostly by BART (53% of all trips) and 11% by bus. This reflects the availability of direct transbay BART service, relatively infrequent Greyhound parallel bus service, and heavy automobile traffic through the Caldecott Tunnel. In contrast, for travel from the Richmond Corridor to

the San Francisco CBD, BART's share is very small (13%), compared with the bus share (53%). This reflects the lack of direct Richmond-to-San Francisco BART service and the availability of good AC Transit transbay bus service.

West Bay, Transbay, and East Bay Trips. Table 16 details mode shares for work trips from origins in the five-corridor primary BART service area by West Bay, transbay, and East Bay travel. BART's share is by far the highest in the transbay corridor (32%); so, too, is the BART-plus-bus transit total (57%). The proportion of carpoolers in the automobile total is also much higher for the San Francisco-Oakland Bay Bridge, reflecting the congested traffic conditions on the bridge and the toll-free priority lanes reserved for carpools at the toll plaza.

The transbay mode distribution shown in Table 16 (BART, 32%; bus, 25%; drive alone, 33%; carpool, 10%) may be compared with the modal distribution of transbay work trips as surveyed in the 1974 transbay survey (BART, 21%; bus, 17%; automobile driver, 46%; automobile passenger, 16%).* The much higher transit percentages given by the work travel survey result from the different populations surveyed: the transbay survey covered all transbay trips, not just those destined for workplaces in the CBD-dominated work travel survey area.

BART's Share of its Potential Work Trip Market

Although the work travel survey was conducted in zones which are, for the most part, reasonably close to a BART station, some workplaces in the survey area are not effectively served by BART. Similarly, the home locations of many work travelers, even if inside the primary BART service area, are considerable distances from BART, especially in

*A detailed discussion of BART's share of transbay travel by purpose, time-of-day, and origin-destination corridor is given in *Immediate Travel Impacts of Transbay BART*, BART Impact Program Document No. DOT-BIP-TM 15-3-75, Peat, Marwick, Mitchell & Co., May 1975.

Table 16

MODAL DISTRIBUTION OF WORK TRIPS:
WEST BAY, TRANSBAY, AND EAST BAY

Usual Mode to Work	Trips Within West Bay	Transbay Trips	Trips Within East Bay	Total
BART	18%	32%	12%	16%
Bus	28	25	7	14
Drive Alone	29	33	65	52
Carpool	6	10	6	6
Walk	17	--	7	9
Other Modes	2	--	3	3
	100%	100%	100%	100%
Total Trips Represented	77,200	29,500	191,500	298,200

Note: Only work trips from origins within the primary BART service area are represented.

Source: BART Impact Program, 1977 Work Travel Survey.

outlying suburban areas where zones are very large. Consequently, a large number of work trips surveyed are not really effectively served by BART.

In an attempt to give a picture of BART's market share relative to the trips it might reasonably be expected to carry, Table 17 shows BART trip shares expressed as a percentage of the total number of trips for which BART is possible as well as its share of all trips. All work trips made by respondents who answered "yes" to the question "Is it possible for you to travel to work on BART?" are considered as "BART possible" trips in this analysis. Obviously this definition depends on travelers' perceptions and knowledge of the BART System and bus connections to it, which vary from person to person. Nevertheless, the percentages shown in Table 17 do give a useful indication of BART's performance relative to its potential. Of the 506,000 daily work trips represented in the work travel survey, 167,200 or 33% are considered possible BART trips. Among the 298,200 trips made from residences in the primary BART service area, 118,300 or 40% are considered possible by BART.

The two sets of percentages in the table give rather different pictures of BART's effective modal shares in the various corridors. Although BART's share of total trips from the Oakland Corridor (11%) is half that for trips from the Concord Corridor (22%), BART trips expressed as a percentage of "BART possible" trips are similar for the two areas (37% and 36%, respectively). The different relationships between the two pairs of percentages ("total" and "BART possible") reflect the fact that the size of the zones and availability of access modes are different for the two areas. Of work trips made by people living in the area defined as the Concord Corridor, 62% are regarded as being possible by BART; of those made by people living in the Oakland Corridor, only 30% are regarded as possible by BART.

For work trips from the Concord Corridor to the San Francisco CBD, BART's share of actual trips (53%) is almost as high as its share of

Table 17

BART'S SHARE OF TOTAL AND POTENTIAL WORK TRIPS BY ORIGIN-DESTINATION CORRIDOR

Origin Residence Area	Destination Workplace Area: San Francisco CBD	San Francisco Other	Oakland CBD	Oakland Other	Richmond Line	Concord Line	Fremont Line	Total
Daly City Corridor	19.9% 51.9	7.7% 34.1	48.2% 54.6	13.4% 17.9	*	*	*	18.2% 48.2
Oakland Corridor	21.1% 25.6	*	8.2% 61.2	6.6% 57.1	9.4% 26.2	*	15.1% 41.8	11.3% 37.3
Richmond Corridor	13.3% 16.2	*	29.2% 35.5	3.3% 9.8	10.6% 46.1	*	11.3% 17.4	12.4% 27.4
Concord Corridor	53.0% 54.9	*	41.4% 43.8	7.1% 9.1	11.8% 14.9	5.6% 27.8	11.2% 13.4	22.2% 35.8
Fremont Corridor	32.7% 40.5	*	32.4% 44.7	14.0% 28.8	23.8% 51.3	*	7.0% 35.2	13.3% 39.0
Subtotal All Corridors (Primary BART Service Area)	23.4% 45.8	11.3% 35.7	26.6% 44.6	8.2% 20.4	11.7% 35.2	6.6% 27.2	8.2% 32.0	15.5% 38.9
BART Express Bus Area	38.2% 41.9	*	21.8% 26.9	*	7.5% 18.0	2.6% 42.2	8.2% 25.2	11.2% 28.8
Other Areas	9.7% 56.4	6.7% 59.3	21.2% 45.2	6.3% 28.6	12.8% 46.0	5.7% 46.9	4.4% 20.6	9.4% 44.2
Total	16.9% 48.2	9.4% 40.7	24.7% 43.1	7.2% 21.0	11.6% 35.6	5.3% 31.4	7.1% 28.9	13.1% 39.5
Total Number of Trips	177,700	27,300	61,100	39,100	40,300	34,000	126,500	506,000
Number of Trips for which BART is Possible	62,500	6,300	35,100	13,400	13,200	5,700	31,000	167,200
Number of BART Trips	30,100	2,500	15,100	2,800	4,700	1,800	9,000	66,000

Note: In each pair of figures, the first figure shows BART trips as a percentage of total origin-destination trips by all modes. The second figure shows BART trips as a percentage of all origin-destination trips for which BART is possible. For example, as shown by the top left pair of figures in the table, of all work trips made from the Daly City Corridor to the San Francisco CBD, 19.9% are made by BART. Of work trips from the Daly City Corridor to the San Francisco CBD for which BART is considered possible, BART carries 51.9%.

*Indicates that less than 1,000 daily trips are made by all modes combined.

Source: BART Impact Program, 1977 Work Travel Survey.

potential trips (55%), because BART is regarded as a possible alternative by virtually all commuters. By contrast, BART's share of potential trips from the Daly City Corridor to the San Francisco CBD (52%) is much higher than its share of actual trips (20%), because BART is regarded as a possible alternative by a smaller proportion of commuters. For trips from all corridors, BART is the first choice mode for 39% of all trips that could (according to the assumptions of this analysis) possibly be made by BART.

Comparison of the socioeconomic characteristics of people who do and do not consider BART as a possible travel mode largely reflects the extent to which BART is oriented to downtown workplaces. Among the respondents who do consider BART a possible mode, 76% are in the "professional and technical," "proprietors, managers, and officials," or clerical" categories, 66% have some college education, and 48% have annual family incomes of $20,000 or more. Among the respondents who do not consider BART a possible mode, the percentages are 54%, 50%, and 36%, respectively.

Without-BART Mode Distribution

To estimate BART's impacts on travel volumes by other modes in the transportation system, assumptions had to be made about the modes BART travelers would use if BART were not available. Estimates of without-BART mode distributions can be developed from the work travel survey data by analyzing the choices made by travelers between BART and bus and between BART and automobile. In the remainder of this report, the usual (or first choice) mode is the one given in the survey questionnaire as the mode used most often in a typical week. The second choice mode is defined as the mode of getting to work that would be the second choice if the first choice were not available.

Questionnaire responses allowed a first choice mode to be assigned in a straightforward manner to respondents in about 90% of cases. Ambiguities arose in the other 10% of cases because of missing responses or because

two or more modes were indicated as being used equally often. These ambiguities were resolved by reference to the second choice mode response or by assuming a heirarchy of modes to resolve ties.

In some cases, ambiguities also arose in defining the second choice mode because of missing responses or because the same mode was given as both the first and second choice mode. These ambiguities were also resolved by a set of consistent decision rules which allowed most respondents to be either assigned a second choice mode or be positively designated as having no second choice available.

However, there remained some respondents for whom insufficient information was given in the questionnaire to allow a determination of second choice mode to be made. These "missing response" respondents were included as having no second choice available, although this was not known positively. Thus the "no second choice available" category is probably significantly overstated.

Use of More Than One Mode

Table 18 shows the distribution of mode usage, with the first choice mode cross-tabulated by the mode "sometimes" used. The total of 2,889,000 trips shown in the table approximates the total number of work trips made in a typical 7-day week by the 506,000 workers included in the survey (5.7 days per worker average).* The table shows the frequency with which different modes are used by commuters.

Among daily work trips made by people whose usual mode is automobile, about 89% are typically made by automobile on a given day; that is, people whose usual mode is driving seldom use other means of getting

*This estimate is slightly greater than the true average number of days worked per worker (Table 14, Chapter IV) because, if two different modes were used for the two halves of the work trip on a single day, each of the two was recorded as a separate mode-day.

Table 18

USUAL FIRST CHOICE MODE AND MODE SOMETIMES USED

Mode Sometimes Used	Usual First Choice Mode							
	BART	Bus	Drive Alone	Car-pool	Walk	S.P. Train	Other	All Modes
Train[a]	65.3%	4.0%	3.5%	12.9%	2.1%	67.5%	4.4%	12.8%
Bus[b]	16.4	80.9	4.4	14.2	7.6	16.3	20.2	21.4
Auto[c]	16.6	9.6	88.8	72.2	6.2	15.4	31.1	56.9
Walk[d]	1.7	5.5	3.3	0.7	84.1	0.8	44.3	8.9
Total All Modes	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weekly Trips Represented[e]	360,000	527,000	1,479,000	261,000	176,000	32,000	54,000	2,889,000
Percent of Total	12.4%	18.2%	51.2%	9.0%	6.1%	1.1%	2.0%	100.0%

a. BART or Southern Pacific train.
b. Bus, streetcar, ferryboat, or taxi.
c. Automobile, truck, or motorcycle.
d. Walking or bicycle.
e. Total estimated number of trips to workplaces in the Work Travel Survey area made in a typical 7-day week.

Note: The table reads column-by-column, for example: Among all trips made to work in a typical week by commuters whose usual first choice mode is BART, 65.3% are made by train, 16.4% by bus, 16.6% by car and 1.7% by walking.

Source: BART Impact Program, 1977 Work Travel Survey.

to work. Of work trips made by people whose usual mode is bus, a rather smaller proportion, 81%, is typically made by bus on a given day; that is, a higher proportion of "usual" bus users sometimes travel to or from work by other modes (mostly automobile). This tendency is even more marked in BART's case. Of trips made by people whose usual mode is BART, typically only 65% are actually made by BART on a given day. The other 35% of trips are made by bus or automobile (about equally).

This "sometimes" use of other modes by usual BART riders to a greater extent than the "sometimes" use of BART by people who usually drive or take the bus accounts for the slightly smaller BART share of trips shown in Table 18 (12.4%) than the BART share shown in Chapter IV, Table 10 (13.1%). It also helps to explain why the total number of commuters estimated by the survey as being BART users is slightly larger than the actual number of people using BART for work trips on a typical day.

First and Second Choice Modes

Table 19 shows the first choice mode cross-tabulated with the second choice mode for all work trips included in the survey.

As noted, the "no second choice available" category shown in Table 19 is inflated by missing observations, and consequently overstates the number of people who can get to work only by their first choice mode. The extent to which the estimate is overstated is not known. Intuitively, however, it seems likely that relatively few people are truly captive to one mode in the sense that it is impossible for them to get to work at all if their usual mode is unavailable. Percentages given in the table are based on the total excluding trips for which "no second choice" is indicated.

As shown in Table 19, among all workers covered by the survey and having BART as their first choice (usual) mode, 59% have automobile as their second choice mode (51% drive alone, 8% carpool), and 36% have bus as their second choice mode. Very few commuters have walking (2%) or other

Table 19

DISTRIBUTION OF FIRST AND SECOND CHOICE MODES FOR WORK TRIPS

Second Choice Mode	First Choice Mode: BART	Bus	Drive Alone	Carpool	Walk	S.P. Train	Other	Total
BART	--	14,463 21.0%	66,255 30.4%	15,632 45.5%	605 3.8%	--	3,022 32.2%	99,977 25.1%
Bus	17,299 35.5%	--	90,473 41.6%	14,419 41.9%	6,884 43.0%	1,734 42.5%	2,511 26.8%	133,320 33.4%
Drive Alone	24,861 51.0%	32,342 47.1%	--	1,576 4.6%	5,921 37.0%	2,196 53.9%	1,998 21.3%	68,894 17.3%
Carpool	3,801 7.8%	6,799 9.9%	23,349 10.7%	--	747 4.7%	146 3.6%	316 3.4%	35,158 8.8%
Walk	1,147 2.4%	7,104 10.3%	10,643 4.9%	476 1.4%	--	--	1,147 12.2%	20,517 5.1%
Southern Pacific Train	96 0.2%	351 0.6%	3,301 1.6%	1,135 3.3%	106 0.7%	--	--	4,989 1.3%
Other Modes	1,585 3.1%	7,650 11.1%	23,715 10.8%	1,155 3.3%	1,736 10.8%	--	388 4.1%	36,229 9.0%
Total Excluding No Second Choice Available	48,789 100.0%	68,709 100.0%	217,736 100.0%	34,393 100.0%	15,999 100.0%	4,076 100.0%	9,382 100.0%	399,084 100.0%
No Second Choice Available	17,240	19,057	49,560	4,902	14,028	475	1,631	106,893
Total	66,029	87,766	267,296	39,295	30,027	4,551	11,013	505,977

Source: BART Impact Program, 1977 Work Travel Survey.

modes (3%) as their second choice. These percentages may be taken as estimates of the modes that current BART work trip riders would most likely use if BART were not available, given current bus service levels, highway traffic congestion, and other transportation costs.

Among workers whose first choice mode is bus, 57% specify automobile as their second choice (47% drive alone, 10% carpool), but only 21% specify BART as the second choice. Significant percentages of those whose first choice is bus specify walking (10%) or other modes (11%) as second choice, reflecting the higher proportion of short commute trips made by bus compared with BART.

Among workers who drive alone or carpool as their first choice, 30% and 45% specify BART as second choice, respectively. These percentages suggest a large "market" of potential BART riders.

Table 20 shows the second choice mode for commuters whose first choice mode is BART according to (1) workplace (San Francisco CBD, Oakland CBD, non-CBD) and (2) travel area (West Bay, transbay, East Bay). Again percentages given in the table are based on totals excluding trips for which no second choice is indicated.

CBD and Non-CBD Work Trips. For travel to the San Francisco CBD, slightly fewer BART users (55%) specify automobile as their second choice mode and correspondingly more (41%) specify bus, compared with the mode choices for the survey area as whole. This reflects the dense network of MUNI bus and streetcar lines from most areas of San Francisco to downtown, and the relatively high parking costs in the central area. Conversely, for trips to the Oakland CBD, a higher percentage (76%) specify automobile as their second choice mode, and a correspondingly smaller percentage (23%) specify bus. Among non-CBD trips (for which BART is selected as the first choice mode by a relatively small percentage of travelers), automobile is specified as the alternative by 49% of BART users and bus by 38%.

Table 20

ALTERNATIVE MODES FOR WORK TRIPS USUALLY MADE BY BART

Second-Choice Mode	Work Trip Destination			
	San Francisco CBD	Oakland CBD	Non-CBD	Total
Bus	41%	23%	37%	36%
Drive Alone	47	71	38	51
Carpool	8	5	11	8
Walk	2	1	6	2
Other Modes	2	--	8	3
	100%	100%	100%	100%
Total Trips Represented[a]	23,800	12,900	12,100	48,800

	Travel Area			
	Trips Within West Bay	Transbay Trips	Trips Within East Bay	Total
Bus	51%	36%	31%	38%
Drive Alone	35	51	52	47
Carpool	6	11	8	8
Walk	4	--	5	3
Other Modes	4	2	4	4
	100%	100%	100%	100%
Total Trips Represented[b]	10,300	8,400	16,300	35,000

a. All BART trips in the work travel survey, excluding trips for which no second-choice mode was specified.
b. BART trips in the work travel survey from origins within the primary BART service area, excluding trips for which no second choice mode was specified.

Source: BART Impact Program, 1977 Work Travel Survey.

West Bay, Transbay, and East Bay Work Trips. In the West Bay, bus is the principal alternative mode to BART; among those commuters whose first choice is BART, 51% specify bus as their second choice and 41% specify automobile. In the East Bay, the reverse is true; among those whose first choice mode is BART, 31% specify bus as their second choice and 60% specify automobile. For transbay travel, 36% specify bus as the alternative and 62% specify automobile.

The travel times, costs, and other characteristics of work journeys made by survey respondents are summarized in this chapter, and the reasons for travelers' choices between alternative modes are analyzed.

Journey Characteristics by Mode of Travel

Door-to-Door Travel Time. Table 21 shows the usual total one-way (door-to-door) travel time for work travelers according to their usual mode of travel to work. The average time for the trip to work is shortest among those who drive to work alone (22 minutes), and longest for those who use BART (51 minutes). Although 83% of all drive-alone work trips are completed in 30 minutes or less, only 18% of BART trips are completed in the same period. BART's share of long-duration trips is correspondingly high: of all work trips by BART, bus, or automobile taking an hour or more, BART carries 52%, bus 34%, and automobile 14%. The longer average BART travel time is what would be expected, given that BART was designed mainly for long-distance commuting. The average BART trip is 12-13 miles long.

Variations in Travel Times. Also shown in Table 21 are the average slowest and fastest expected total trip times. Together, these estimates show the variations in usual trip times to be greatest among carpoolers, whose trip times understandably tend to be at the mercy of the collective punctuality of carpool participants. BART riders evidence the next widest range of usual trip times. Although BART travelers are subject to greater total variations in travel time than bus riders, the difference between the two modes is not significant when the variation is compared with the average usual trip time. The fastest-minus-slowest average time for BART is 37% of the usual average time; the corresponding percentage for bus is 38%. Interestingly, the corresponding percentage for the drive alone category (54%) is higher than for either BART or bus, and for carpoolers it is higher still (100%).

Table 21

JOURNEY-TO-WORK TRAVEL TIMES BY USUAL TRAVEL MODE

	Usual Principal Travel Mode			
	BART	Bus	Drive Alone	Carpool
Total One-Way Door-to-Door Travel Time (Minutes)				
15 or less	1.4%	4.3%	42.9%	17.3%
16 to 30	17.0	28.3	39.5	47.4
31 to 45	28.6	30.9	13.1	22.9
46 to 60	30.1	24.6	3.3	9.9
61 to 75	13.8	5.7	0.6	1.4
Over 75	9.0	6.2	0.6	1.1
	100.0%	100.0%	100.0%	100.0%
Average Usual Travel Time	50.5	43.2	21.8	29.3
Variations in Travel Time (Minutes)				
Average Slowest Travel Time	59.6	50.2	30.4	53.8
Average Fastest Travel Time	40.9	33.8	18.6	24.5
Difference	18.7	16.4	11.8	29.3
Total Trips Represented	66,000	87,800	267,300	39,300

Source: BART Impact Program, 1977 Work Travel Survey.

Travel Time Components. Table 22 provides further details on travel time components and other characteristics of work journeys usually made by BART or bus. The table shows that it takes the typical BART rider an average of 13 minutes to reach the BART station from home, 3 minutes longer than it takes for a bus rider to travel to the bus stop. The average time from BART station to workplace destination (9 minutes) is a minute more than from bus stop to workplace. It is interesting that, although there are considerably fewer BART stations than bus stops in the Bay Area, the access times reported by respondents using BART and bus are very similar.

The average time spent on the BART train during a work trip is less than the average time spent on the bus, even though BART total door-to-door trip times are on average longer than bus trips. This difference is explained by longer access times to BART stations (including waiting) than to bus stops. Table 22 shows that 22% of BART commuters spend 15 minutes or less actually riding on the BART train; only 12% of bus riders spend less than 15 minutes on the bus.

Access Mode Distribution. The distribution of modes used by commuters to get from home to BART (not shown on the table) is walking 18%, bus 30%, and automobile 52%. The distribution of modes used to get from home to the (principal) bus mode is 81% walking, 9% bus, and 10% automobile. At the destination end of the trip, the mode distribution from BART to workplace is walking 84% and bus 16%. From bus to the workplace the distribution is walking 82% and bus 18%.

Number of Vehicles Used. Table 22 also shows that, although almost 62% of bus riders use only one vehicle in the course of their work trip, 17% of BART riders use only one vehicle. The average number of vehicles used (which indicates the number of transfers required) by survey respondents who take the bus as their principal mode of travel to

Table 22

JOURNEY-TO-WORK CHARACTERISTICS FOR BART AND BUS TRIPS

	Usual Principal Travel Mode	
	BART	Bus
Time Spent Getting From Home to Principal Travel Mode (Minutes)		
5 or less	19.9%	51.1%
6 to 10	32.3	23.3
11 to 15	22.7	7.9
16 to 20	11.9	4.3
21 to 30	9.1	5.1
Over 30	4.1	8.3
	100.0%	100.0%
Average	13.3	10.1
Time Spent on Principal Travel Mode (Minutes)		
15 or less	21.8%	12.3%
16 to 30	43.4	42.0
31 to 45	20.5	27.9
46 to 60	12.2	13.2
61 to 75	1.5	2.5
Over 75	0.6	2.1
	100.0%	100.0%
Average	26.7	30.8
Time Spent Getting to Workplace From Principal Travel Mode (Minutes)		
5 or less	53.9%	56.0%
6 to 10	24.4	18.7
11 to 15	9.5	7.0
16 to 20	4.7	4.3
21 to 30	4.2	6.7
Over 30	3.3	7.3
	100.0%	100.0%
Average	9.4	7.9

Table 22 (Continued)

	Usual Principal Travel Mode	
	BART	Bus
Total Number of Vehicles Used		
1	17.4%	61.8%
2	65.9	33.1
3	13.8	4.3
4 or more	2.9	0.8
	100.0%	100.0%
Average number	2.0	1.4
Round Trip Transit Fare		
Less than $0.50	2.6%	5.7%
$0.50 to $0.99	25.9	68.9
$1.00 to $1.49	22.6	10.4
$1.50 to $1.99	18.3	5.0
$2.00 to $2.49	14.3	5.5
$2.50 to $2.99	13.0	2.6
$3.00 or more	3.3	1.9
	100.0%	100.0%
Average	$1.52	$0.83
Sampe Size Represented	66,00	87,800

Source: BART Impact Program, 1977 Work Travel Survey.

work is 1.4, whereas for BART users it is 2.0. These estimates are consistent with the access mode distributions given in the preceding paragraph: compared with bus riders, a far higher percentage of BART riders use automobile or bus as access modes.

Transit Fares. Table 22 shows that the average BART round trip commute fare is almost double the average bus round trip commute fare. According to the table, 29% of BART work travelers pay less than $1.00 in fares daily; the corresponding percentage among bus commuters is 75%. The higher average BART fare reflects BART's distance-graduated fare structure and the greater length of trips on BART (averaging 12-13 miles).

Definition of Choice Samples

As indicated by the survey, the total population of commuters choosing between BART and bus (as their first or second choice modes) is 31,800. Of these commuters, 54% choose BART over bus, and 46% choose bus over BART. Of the 91,100 commuters having BART and driving alone as their first or second choice modes, 27% choose BART over automobile and 73% choose automobile over BART. These four traveler groups (BART over bus, bus over BART, BART over automobile, automobile over BART) are analyzed in the following sections.

Choices Between BART and Bus

Tables 23, 24, and 25 summarize the analysis of data for the sample of travelers choosing between BART and bus for their journeys to work. Information is given separately for those who usually choose BART in preference to bus and those who usually choose bus in preference to BART. Within each of these two groups, information on trip characteristics is given for both the BART and bus alternatives.

Table 23 provides information on the usual average travel time and its components (getting from home to the bus or BART, riding in the vehicle, and getting from the vehicle to the workplace); the average day-to-day

Table 23

ALTERNATIVE JOURNEY-TO-WORK CHARACTERISTICS:
TRAVELERS CHOOSING BETWEEN BART AND BUS[a]

	Travelers Choosing BART over Bus		Travelers Choosing Bus over BART	
	BART Trip	Bus Trip	BART Trip	Bus Trip
Traveler Population	17,300		14,500	
Usual Travel Time (minutes)				
To Mode	12	13	14	10
On Mode	26	32	28	26
From Mode	8	12	9	10
Total	46	57	51	46
Slowest Travel Time (minutes)	54	63	61	53
Fastest Travel Time (minutes)	36	44	40	39
Difference	18	19	21	14
Number of Vehicles Used	1.9	1.7	2.1	1.5
Round Trip Fare	$1.34	$0.93	$1.44	$0.97

a. Bus mode includes streetcar.

Source: BART Impact Program, 1977 Work Travel Survey.

variation in total travel time; the number of vehicles used during the trip; and the average round trip fare. Table 24 summarizes travelers' satisfaction with both the quantitative (time and cost) service attributes and other less easily quantifiable attributes. Table 25 provides estimates of the importance attached to the various service factors by commuters choosing between BART and bus (1) as reported directly by questionnaire respondents and (2) as inferred from the coefficients of explanatory mode choice models.*

Reported Travel Times and Costs. Table 23 shows that people choosing BART over bus report an average 11-minute one-way trip time advantage by BART (46 minutes by BART, 57 minutes by bus), but they pay much more for the trip than if they take the bus, and typically have to transfer between vehicles more often in their BART trip.

Satisfaction Ratings. Table 24 shows that those who have BART as their first choice give higher ratings to BART on all attributes than do those who have BART as their second choice. However, the satisfaction ratings given for BART, when compared relatively among the eight attributes, are very similar for both BART-over-bus and bus-over-BART groups. Thus, BART is consistently given high ratings on security and flexibility and low ratings on dependability and cost.

Similarly, for the bus ratings given in Table 24, satisfaction is higher for all attributes among those whose first choice mode is bus than among those whose first choice mode is BART. But in relative terms, the satisfaction with bus service attributes is similar for the two choice groups. Bus is consistently given high ratings on total cost and chance of seat and low ratings on security and flexibility.

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*Descriptions of the explanatory mode choice models are given in the Appendix B.

Table 24

SATISFACTION WITH ALTERNATIVE MODE ATTRIBUTES:
TRAVELERS CHOOSING BETWEEN BART AND BUS[a]

Service Attribute	Average Satisfaction Ratings[b]					
	Travelers Choosing BART over Bus			Travelers Choosing Bus over BART		
	BART Trip	Bus Trip	Difference	BART Trip	Bus Trip	Difference
1. Total door-to-door trip cost	4.5	5.6	-1.1	3.6	5.9	-2.3
2. Time spent walking	5.8	5.4	0.4	5.3	6.0	-0.7
3. Dependability of arriving on time	4.3	4.1	0.2	3.1	5.5	-2.4
4. Chances of getting a seat	4.7	4.4	0.3	3.8	5.7	-1.9
5. Security from crime and unpleasant behavior	5.4	3.8	1.6	5.1	5.1	0.0
6. Ability to do what you want while traveling	5.3	4.2	1.1	4.9	5.4	-0.5
7. Flexibility to travel when you want to	4.6	4.0	0.6	4.2	4.7	-0.5
8. Total door-to-door travel time	4.6	3.4	1.2	3.4	5.3	-1.9

a. Bus mode includes streetcar.
b. Attribute satisfaction ratings obtained from 7-point semantic differential scales where very satisfied = 7, very dissatisfied = 1.

Source: BART Impact Program, 1977 Work Travel Survey.

Examination of the differences between the BART and bus ratings (BART-minus-bus) in Table 24 shows that BART has the greatest satisfaction rating advantage over bus for the attributes of security, ability to do what you want while traveling, flexibility, and total time. Bus shows the greatest satisfaction advantage over BART for the attributes of dependability, cost, chance of seat, and walking time. The satisfaction ratings of Table 24 correlate closely with the information on travel times and costs given in Table 23.

Importance Ratings. Table 25 shows clearly that the factors people say are important to them vary as a function of their first choice mode. For example, travel cost (for which both BART and bus users give higher satisfaction ratings for bus than they do for BART), is considered the most important of all factors by people choosing bus over BART but is mentioned by relatively few people choosing BART over bus. Similarly, dependability is given a high importance rating by people choosing bus over BART, but a much lower rating by people choosing BART over bus.

To some extent, these differences may reflect travelers' justifications of their own decisions. That is, people who choose BART over bus may be unwilling to admit that travel cost and dependability are important to them, given that they know (or judge) the bus to be less expensive and more reliable. However, the differences between the importance rankings for BART and bus choosers also reflect the different preferences of the two groups. People to whom cost is important are less likely to choose the more expensive BART alternative (other things being equal), and people to whom reliability is important are less likely to choose the less reliable BART alternative.

Although there are obvious differences between BART and bus users with regard to the importance ratings shown in Table 25, there are also significant commonalities among the set of factors rated as most important in travelers' decisions. Travel time, waiting time, inconvenience (which

Table 25

IMPORTANCE OF FACTORS IN MODE CHOICES:
TRAVELERS CHOOSING BETWEEN BART AND BUS[a]

A. FACTORS DIRECTLY REPORTED AS IMPORTANT BY SURVEY RESPONDENTS

Factor[c]	Importance Rating[b]: Travelers Choosing BART over Bus	Travelers Choosing Bus over BART
Total travel costs	21	100
Total travel time	100	44
Time spent waiting and transferring	49	40
Convenience	59	67
Reliability and regularity	26	67
Crowding	17	26
Comfort	18	5
Safety and security	23	4
Flexibility and independence	6	1

a. Bus mode includes streetcar.
b. Importance ratings were derived by summing the number of times each factor was mentioned by respondents as being the first, second, third, or fourth most important reason for their travel choice, and then normalizing so the most frequently mentioned equals 100.
c. The survey questionnaire asked respondents to list the important reasons for their travel choice in their own words. Questionnaire responses were grouped by the factors listed. Other reasons mentioned by respondents which do not specify a service characteristic, such as "method difficult to arrange" or "prefer usual method," are excluded.

B. FACTORS INFERRED AS IMPORTANT BY EXPLANATORY MODE CHOICE MODEL

Factor[d]	Importance Estimate[e]
Total door-to-door travel time	100
Ability to do what you want while traveling	92
Time spent walking	88
Dependability of arriving on time	63

d. Factors are as defined in the survey questionnaire. See Table 11.
e. Importance estimates are ratios of coefficients from the mode choice model, scaled so that the most important factor equals 100.

Source: BART Impact Program, 1977 Work Travel Survey.

is probably closely linked with walking time), and unreliability together account for 73% of all responses shown in the table among people choosing BART over bus, the same four attributes account for 62% of all responses among people choosing bus over BART.

Comparison of the reported importance ratings (given in the top part of Table 25) with the inferred importance estimates (given in the bottom part) shows that, if it is assumed that "inconvenience" is closely identified with the time spent walking, the two sets of results are consistent in the conclusion that overall, travel time (particularly time spent walking to and from and waiting for the bus or BART) and the travel time-related attribute of dependability are overwhelmingly the most important considerations to people choosing between BART and bus for their work journeys.* Comfort and other qualitative differences between BART and bus (on which great emphasis was placed in the design of BART) are not indicated as nearly such important factors in travelers' mode choices.

Choices Between BART and Automobile

Tables 26, 27, and 28 present information corresponding to that given in Tables 23, 24, and 25, respectively, except that it is for the sample of travelers choosing between BART and driving alone (or with a family member) rather than between BART and bus.**

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*The attribute of "ability to do what you want while traveling," which is inferred as important in the explanatory model results of Table 25, is mentioned by virtually no one in the directly reported importance ratings of the table. This discrepancy probably reflects the high correlations existing between the activity en route variable and others such as security (correlation coefficient 0.50) and chance of seat (correlation coefficient 0.54) which influence the explanatory model output.

**The sample used in estimating the explanatory model results given in the second part of Table 28 differs slightly from the sample analyzed in Tables 26, 27 and the first part of Table 28 in that the data used to estimate the mode choice model are not weighted to account for non-response bias. In addition, driving alone is defined to mean just that (people driving with family members are excluded). Certain respondents are also screened out of the mode choice model analysis on the basis that they do not effectively have a choice: people who need a car for work, people who do not drive, and people who do not have an automobile available.

Reported Travel Times and Costs. As shown in Table 26, the average journey to work on BART takes much more time than the alternative trip by automobile, both for people who usually drive and people who usually take BART. For people who usually drive, the alternative trip would take twice as long by BART (27 minutes driving, 55 minutes by BART). For people who usually take BART, the BART trip is 18 minutes longer than the alternative trip by automobile (52 minutes by BART, 34 minutes driving). However, this longer trip time is offset by the much lower trip cost by BART. Average BART trip fares are considerably lower than average parking and bridge toll costs alone (without any allowance for gasoline and other running costs).*

Satisfaction Ratings. As shown in Table 27, people who choose BART over the automobile rate their satisfaction with BART's attributes consistently higher than do those who choose the automobile over BART. Similarly, those who choose the automobile rate their satisfaction with the automobile consistently higher than those who choose BART. But, discounting this overall shift in the satisfaction ratings, the rankings of satisfaction with the various attributes (within a given column of the table) are almost identical for either BART or the automobile, no matter which is specified as the first choice mode.

Satisfaction ratings for BART are high for walking time, security, and ability to do what you want while traveling, and low for dependability and total time. The automobile is rated highest on flexibility to travel when you want to and walking time. The relative (BART-minus-automobile) satisfaction ratings show that the automobile is regarded more favorably

*The survey was conducted in June, July, and August 1977. Effective July 1, 1977, tolls on the San Francisco-Oakland Bay Bridge and the San Mateo-Hayward Bridge were increased to $0.75 (from $0.50 and $0.70, respectively). Thus, some responses are for pre-increase tolls, and some are for post-increase tolls.

Table 26

ALTERNATIVE JOURNEY-TO-WORK CHARACTERISTICS:
TRAVELERS CHOOSING BETWEEN BART AND AUTOMOBILE[a]

	Travelers Choosing BART over Automobile		Travelers Choosing Automobile over BART	
	BART Trip	Auto Trip	BART Trip	Auto Trip
Traveler Population	24,900		66,300	
Usual Travel Time (minutes)				
To Mode	13	--	14	--
On Mode	30	--	29	--
From Mode	8	--	12	--
Total	52	34	55	27
Slowest Travel Time (minutes)	62	48	63	39
Fastest Travel Time (minutes)	41	27	43	22
Difference	21	21	20	17
Number of Vehicles Used	2.0	1.0	2.3	1.0
Round Trip Fare	$1.62	$ --	$1.58	$ --
Parking and Bridge Tolls	$ --	$2.55	$ --	$1.83

a. Automobile defined as driving alone (or with a family member) by automobile, truck, or motorcycle.

Source: BART Impact Program, 1977 Work Travel Survey.

Table 27

SATISFACTION WITH ALTERNATIVE MODE ATTRIBUTES:
TRAVELERS CHOOSING BETWEEN BART AND AUTOMOBILE[a]

Service Attribute	Average Satisfaction Ratings[b]					
	Travelers Choosing BART over Automobile			Travelers Choosing Automobile over BART		
	BART Trip	Auto Trip	Difference	BART Trip	Auto Trip	Difference
1. Total door-to-door trip cost	4.6	3.8	0.8	4.1	5.3	-1.2
2. Total door-to-door travel time	4.4	5.7	-1.3	3.1	6.1	-3.0
3. Time spent walking	6.0	6.1	-0.1	4.9	6.5	-1.6
4. Dependability of arriving on time	4.0	5.8	-1.8	3.3	6.3	-3.0
5. Chances of getting a seat	4.8	7.0[c]	-2.2	4.3	7.0[c]	-2.7
6. Security from crime and unpleasant behavior	5.5	6.1	-0.6	4.8	6.4	-1.6
7. Ability to do what you want while traveling	5.4	5.1	0.4	4.8	5.8	-1.0
8. Flexibility to travel when you want to	4.6	6.2	-1.6	3.6	6.6	-3.0

a. Automobile defined as driving alone (or with a family member) by automobile, truck, or motorcycle.
b. Attribute satisfaction ratings obtained from 7-point semantic differential scale where very satisfied = 7, very dissatisfied = 1.
c. Assumed value (chance of seat attribute not included in questionnaire for auto).

Source: BART Impact Program, 1977 Work Travel Survey.

than BART on all eight attributes among people who choose the automobile, and on all but two attributes (cost and ability to do what you want while traveling) even among people who choose BART. (This is in contrast to the BART-bus analysis of Table 24 where, among people who choose BART, BART is rated higher than the bus for seven out of eight attributes.) Satisfaction with BART is highest (relative to the automobile) for the ability to do what you want while traveling and cost, and lowest for dependability and total time.

Importance Ratings. As in the BART-bus analysis, Table 28 reveals noticeable differences in the mode choice factors reported as important, depending on whether BART or the automobile is the first choice mode. Among people who choose BART over driving, cost and a dislike for driving in congested traffic are listed most frequently as important factors. (This is consistent with the observation in the previous paragraph that, among people who choose BART over driving, BART is rated higher than the automobile on only two attributes, cost and the ability to do what you want while traveling.) Reliability is mentioned as important by a trivial number of people choosing BART over driving. In contrast, reliability is one of the top three most important attributes listed by people choosing driving over BART.

In addition, there is an obvious difference in the importance attached to travel time and time-related attributes by the different groups. Among people who choose BART over driving, the travel time, waiting time, inconvenience, and unreliability factors together account for only 13% of the responses given in Table 28. In contrast, among people who choose driving over BART the figure is 63%. Apparently people who elect to ride BART accept that it takes longer and is less reliable than driving, but feel that these disadvantages are outweighed by the advantages of BART. These advantages are primarily BART's lower cost and the opportunity it affords to commuters to avoid driving in congested traffic and so make

Table 28

IMPORTANCE OF FACTORS IN MODE CHOICES:
TRAVELERS CHOOSING BETWEEN BART AND AUTOMOBILE[a]

A. FACTORS DIRECTLY REPORTED AS IMPORTANT BY SURVEY RESPONDENTS

Factor[c]	Importance Rating[b]: Travelers Choosing BART Over Automobile	Importance Rating[b]: Travelers Choosing Automobile Over BART
Total travel cost	100	63
Total travel time	12	92
Time spent waiting and transferring	2	51
Convenience	12	100
Reliability and regularity	4	73
Crowding	--	19
Comfort	3	3
Safety and security	7	17
Flexibility or independence	1	22
Ability to make use of travel time	11	1
Dislike of driving in traffic	52	--
Parking unavailable or difficult	16	16
Car needed at work	--	42
Inconvenience to family members	9	5

a. Automobile defined as driving alone (or with a family member) by automobile, truck, or motorcycle.
b. Importance ratings were derived by summing the number of times each factor was mentioned by respondents as being the first, second, third, or fourth most important reason for their travel choice, and then normalizing so the most frequently mentioned equals 100.
c. The survey questionnaire asked respondents to list the important reasons for their travel choice in their own words. Questionnaire responses were grouped by the factors listed. Other reasons mentioned by respondents which do not specify a service characteristic, such as "method difficult to arrange" or "prefer usual method," are excluded.

B. FACTORS INFERRED AS IMPORTANT FROM EXPLANATORY MODE CHOICE MODEL

Factor[d]	Importance Estimate[e]
Total door-to-door trip cost	100
Time spent walking	83
Total door-to-door travel time	82
Security from crime and unpleasant behavior	52
Ability to do what you want while traveling	26

d. Factors are so defined in the survey questionnaire. See Table 11.
e. Importance estimates are ratios of coefficients from the mode choice model, scaled so that the most important factor equals 100.

Source: BART Impact Program, 1977 Work Travel Survey.

better use of their time while traveling. As with the BART-bus choice sample, the "qualitative" attributes of safety, security, comfort, and crowding are reported by very few people as important in their choices between BART and the automobile.

These findings tend to be supported by the results of the explanatory modeling analysis, given in the bottom part of Table 28. Travel time and walking time are indicated as the most important factors in peoples' choices between BART and driving. Again, it is reasonable to assume that the "inconvenience" quoted by many respondents, although not precisely defined, correlates with the time they must spend walking and waiting.

Journey-to-Work Travel Times for East Bay, Westbay, and Transbay Trips

Table 29 shows the components of journey times for survey respondents stratified according to (1) trips made entirely within the East Bay, (2) trips made entirely within the West Bay, and (3) trips between homes and workplaces on opposite sides of the San Francisco Bay. The journey times are further stratified according to whether a mode choice is made between BART and bus or between BART and automobile (drive alone). (These data supplement those given in Tables 23 and 26).

Data given in Table 29 show that trips made by any given mode within the East Bay and West Bay are of similar duration. Transbay trips are significantly longer. Travel times for BART trips and bus trips are generally about the same; however, BART trips are about twice as long on average compared with trips by automobile for all three categories of work trip.

Table 29

ALTERNATIVE JOURNEY-TO-WORK TRAVEL TIMES: EAST BAY, WEST BAY, AND TRANSBAY TRIPS

	East Bay		West Bay		Transbay	
	BART Over Bus (BART Trip)	Bus Over BART (Bus Trip)	BART Over Bus (BART Trip)	Bus Over BART (Bus Trip)	BART Over Bus (BART Trip)	Bus Over BART (Bus Trip)
Traveler Population	6,100	4,200	7,800	5,500	3,400	4,800
Usual Travel Time (minutes)						
To Mode	12	11	12	11	11	8
On Mode	26	22	23	24	36	33
From Mode	9	11	8	10	9	9
Total	47	44	43	45	56	50

	East Bay		West Bay		Transbay	
	BART Over Auto (BART Trip)	Auto Over BART (Auto Trip)	BART Over Auto (BART Trip)	Auto Over BART (Auto Trip)	BART Over Auto (BART Trip)	Auto Over BART (Auto Trip)
Traveler Population	12,700	50,000	7,700	11,000	4,500	5,300
Usual Travel Time (minutes)						
To Mode	12	--	14	--	13	--
On Mode	29	--	28	--	42	--
From Mode	8	--	8	--	8	--
Total	49	26	50	26	63	35

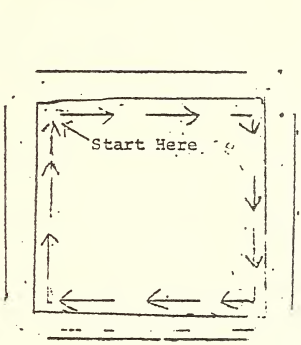
Source: BART Impact Program, 1977 Work Travel Survey.

APPENDIX A

SURVEY QUESTIONNAIRE AND OTHER SURVEY MATERIALS

Figure A-1
BLOCK ENUMERATION SHEET

ock No.____ County_____ City_____ RTZ_____



Note: Exclude any residential buildings or floors

St. No.	St. Ave. Floors	St. No.	St. Ave. Floors	St. No.	St. Ave. Floors	St. No.	St. Ave. Floors

Figure A-2
FLOOR ENUMERATION SHEET

MANAGEMENT INFORMATION ASSOCIATES

WORKPLACE SURVEY FLOOR ENUMERATION SHEET NO._____

Tab Block No._____ Block Sheet No._____ RTI_____

Street Address_____ City_____County_____

Floor_____ Page___of___Pages (for this floor)

Enumerator_____

Name of Company			
Mailing Address (if different from above)			
Zip Code			
Phone Number			
Person to Contact and Title			
Nature of Business			
Number of Persons Company, Total	_____	_____	_____
Men	_____	_____	_____
Women	_____	_____	_____
On Floor, Total	_____	_____	_____
Men	_____	_____	_____
Women	_____	_____	_____
Code	A B C	A B C	A B C
NOTES			

Figure A-3
WORKPLACE CARD

MANAGEMENT INFORMATION ASSOCIATES WORKPLACE SURVEY

Employer_____ Phone_____

Address_____ City_____

Floor No.____ Employer No._____ Est. No. workers____

Person to contact_____ Title_____

Date letter mailed / /77 Phoned for plcmnt. appt. / /77

Questionnaires left / /77 No. questionnaires left_____
(Current workers)

Appt. for pickup / /77 Date phoned re pickup / /77

Date first pickup / /77 Number picked up_____

Date subsequent pickup / /77 Number picked up_____

Assigned to_____ Date / /77

OVER FOR NOTES

Figure A-4
PRETEST QUESTIONNAIRE

Approved OMB No. 004S7[illegible]
Expires September, 1977

METROPOLITAN TRANSPORTATION COMMISSION
TRANSPORTATION SURVEY

The questions in this booklet are part of a survey being conducted by the Metropolitan Transportation Commission to help them plan better transportation facilities in the Bay Area. The survey is being sponsored by the U.S. Department of Transportation and the U.S. Department of Housing and Urban Development.

This survey is authorized by the U.S. Department of Transportation Act (P.L. 89-670, Sec. 4(2)). While you are not required to respond, your cooperation is needed to make the results of the survey comprehensive, accurate, and timely. Neither your name nor that of your employer will be used in the report. Only totals and averages for large groups of people will be reported. *If some questions don't seem to apply to your situation, or if you don't know the answer to a question, please write in an explanation.*

Location of place where you work: _____
Number and street, or intersection *City* *Zip*

What kind of work do you do? _____
(For example: TV repairman, spray painter, civil engineer)

What is your job title? _____

How long have you been working at this particular location? . . . . . _____ YEARS AND _____ MONTHS

Circle which days of the week you usually work at this location. . . . . MON TUES WED THURS FRI SAT SUN

On a typical work day, what are your work hours here? . . . . . _____ AM/PM TO _____ AM/PM

How important is it to you that your method of transportation to work never causes you to be more than ten minutes late? . . . . . ☐ VERY IMPORTANT
☐ SOMEWHAT IMPORTANT
☐ NOT IMPORTANT

Do you usually travel to work directly from your residence? . . . . . ☐ YES
☐ NO

We don't need your exact address, but we do need the following information about where you live: . . . CITY _____ STREET _____
NEAREST INTERSECTING STREET _____ ZIP _____

How long have you lived there? . . . . . _____ YEARS AND _____ MONTHS

Where did you live before you moved to your present residence? _____
City *County* *State*

On the next page are questions about methods of transportation you might take to work. The main types of transportation used for the *major part* of a trip to work are shown at the tops of four columns. Please answer the questions at the left for each method you might use to travel to work.

Figure A-4 (Continued)

PLEASE ANSWER THE QUESTIONS LISTED BELOW IN THE SPACES PROVIDED IN THE COLUMNS UNDER THE FOUR MAJOR TRANSPORTATION METHODS AT RIGHT.	Method of transportation you now use or might use for the *longest part* of a trip to work.			
	TRAIN S.P. OR BART	**BUS,** STREETCAR, FERRY, OR TAXI	**AUTOMOBILE,** TRUCK OR MOTORCYCLE	**WALKING,** BICYCLE ALL THE WAY
START WITH THE FIRST COLUMN				
Is the method listed at the top of the column *practical* for you to use to get to and from work, *if you wanted to*?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
	IF YOU CHECKED "YES" ABOVE, PLEASE ANSWER ALL THE QUESTIONS DOWN THIS COLUMN BEFORE GOING ON TO THE NEXT COLUMN. OTHERWISE, GO TO THE NEXT COLUMN.	IF YOU CHECKED "YES" ABOVE, PLEASE ANSWER ALL THE QUESTIONS DOWN THIS COLUMN BEFORE GOING ON TO THE NEXT COLUMN. OTHERWISE, GO TO THE NEXT COLUMN.	IF YOU CHECKED "YES" ABOVE, PLEASE ANSWER ALL THE QUESTIONS DOWN THIS COLUMN BEFORE GOING ON TO THE NEXT COLUMN. OTHERWISE, GO TO THE NEXT COLUMN.	IF YOU CHECKED "YES" ABOVE, PLEASE ANSWER ALL THE QUESTIONS DOWN THIS COLUMN BEFORE GOING ON TO THE NEXT PAGE. OTHERWISE, GO TO THE NEXT PAGE.
Is this the one method you use most often to get to and from work?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
Write in the number of times you actually use each method to get *to work* in a typical week.	____ TIMES	____ TIMES	____ TIMES	____ TIMES
Check how you do or would make the major part of the trip. . .	☐ SOUTHERN PACIFIC ☐ BART ________ *Station get on* ________ *Station get off*	☐ A-C TRANSIT ☐ GREYHOUND ☐ GOLDEN GATE BUS ☐ MUNI ☐ FERRY ☐ TAXI ☐ OTHER: ________	☐ AUTOMOBILE ☐ TRUCK ☐ MOTORCYCLE Number persons usually in car____ (including driver) ☐ Drive alone or with family. ☐ Drive or ride with others (car pool)	☐ WALK ☐ BICYCLE
How many minutes, including waiting time, would this part of the trip usually take?	____ MINUTES	____ MINUTES	____ MINUTES	____ MINUTES
Please indicate how you do or how you would travel *to* the major method of transportation checked above.	☐ WALK OR BICYCLE ☐ BUS ☐ AUTOMOBILE ☐ OTHER: ________	☐ WALK OR BICYCLE ☐ BUS ☐ AUTOMOBILE ☐ OTHER: ________	☐ WALK OR BICYCLE ☐ BUS ☐ AUTOMOBILE ☐ OTHER: ________	

How many minutes, including waiting time, would this part of the trip usually take?	____MINUTES	____MINUTES	____MINUTES	
Please indicate how you do or how you would travel *from* the major method of transportation checked above to your place of work.	☐WALK ☐BUS ☐OTHER: _____	☐WALK ☐BUS ☐OTHER: _____	☐WALK ☐BUS ☐OTHER: _____	
How many minutes, including waiting time, would this part of the trip usually take?	____MINUTES	____MINUTES	____MINUTES	
Indicate how many minutes it does or would take for the entire door-to-door trip, from home to work.	_____ *Average time*	_____ *Average time*	_____ *Average time*	_____ *Average time*
Then indicate the fastest time and slowest time you would expect.	_____ *Fastest time* _____ *Slowest time*	_____ *Fastest time* _____ *Slowest time*	_____ *Fastest time* _____ *Slowest time*	_____ *Fastest time* _____ *Slowest time*
How many times do you or would you have to change vehicles during the trip?	____TIMES	____TIMES	____TIMES	
Indicate how much the daily *round trip* costs you for:				
Transit fares (round trip)	$_____	$_____	$_____	
Bridge toll			$_____	
Parking (per day)	$_____	$_____	$_____	
What is the total auto mileage (round trip)?	____MILES	____MILES	____MILES	

Given below are some factors which people consider in choosing their method of transportation. Listed beside each factor is a scale of scores from 1 to 7. If you are very *satisfied* with a factor for this method of transportation you should circle 7. If you are very dissatisfied with a factor, you should circle 1. If you feel a factor is so-so circle 4, and so on along the scale.

	VERY SATISFIED — VERY DISSATISFIED	VERY SATISFIED — VERY DISSATISFIED	VERY SATISFIED — VERY DISSATISFIED	VERY SATISFIED — VERY DISSATISFIED
Security from crime and unpleasant behavior of others	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1
Flexibility to travel when you want to	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1
Dependability of arriving on time	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1
Your total door-to-door travel time	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1
Total cost of your door-to-door trip	7 6 5 4 3 2 1	7 6 5 4 3 2 1	7 6 5 4 3 2 1	
Your chance of getting a seat	7 6 5 4 3 2 1	7 6 5 4 3 2 1		
	NOW GO ON TO THE NEXT COLUMN	NOW GO ON TO THE NEXT COLUMN	NOW GO ON TO THE NEXT COLUMN	NOW GO ON TO THE NEXT PAGE

Figure A-4 (Continued)

Figure A-4 (Continued)

Which one method of getting to work would be your second choice, if your usual method were not available? . . . . _____

Please write in the most important reasons why your second choice method is not the one you usually use. Write the most important reason first. . . . . _____

_____

Do you drive an automobile or other motor vehicle? . . . . . ☐YES ☐NO

IF YES: Do you usually need a car for your work? . . . . . ☐YES ☐NO

IF YOU CAN DRIVE BUT USUALLY DON'T DRIVE TO WORK:

How easy would it be for you to obtain an automobile to drive to work? . . . ☐VERY EASY ☐A LITTLE DIFFICULT ☐VERY DIFFICULT

Do you have any physical disability that has lasted six months or more, which limits or prevents your getting to or using any of the transportation methods listed on the preceding page? . . . . . ☐YES ☐NO

IF YOU DO: Please explain. _____

_____

What factors led to your decision to accept your present job? CHECK ALL THAT APPLY:

___ ☐ NO CHOICE, NEEDED A JOB AND THIS WAS THE FIRST ONE AVAILABLE
___ ☐ TRANSFERRED
___ ☐ WANTED TO MOVE TO THE BAY AREA
___ ☐ CONVENIENT TO HOME, SHORTER COMMUTE
___ ☐ CONVENIENT TO STORES, SHOPPING AND OTHER ACTIVITIES, DOWNTOWN LOCATION
___ ☐ OTHER (SPECIFY): _____
___ ☐ CONVENIENT TO PUBLIC TRANSPORTATION
___ ☐ CONVENIENT TO ANOTHER PLACE I WORK OR ANOTHER MEMBER OF HOUSEHOLD WORKS
___ ☐ CAREER OR PROFESSIONAL ADVANCEMENT; BETTER PAY
___ ☐ INTERESTING WORK
___ ☐ DISSATISFIED WITH PREVIOUS JOB

NOW INDICATE THE ORDER OF IMPORTANCE OF THE REASONS YOU CHECKED ABOVE. WRITE "1" NEXT TO THE CHECK BOX THAT DESCRIBES THE *MOST IMPORTANT* REASON FOR YOUR CHOICE. WRITE "2" NEXT TO THE CHECK BOX FOR THE NEXT MOST IMPORTANT REASON, AND SO ON.

WE WOULD LIKE SOME FURTHER INFORMATION ABOUT YOU TO HELP US ANALYZE THE SURVEY. AS YOUR NAME DOES NOT APPEAR ON THIS QUESTIONNAIRE, YOU CAN BE ASSURED OF ANONYMITY.

What is your sex? . . . . . ☐MALE ☐FEMALE

What is your age? . . . . . _____

Do you own or rent your home? ☐OWN ☐RENT

Including yourself, how many people live in your household? _____

How many of these are currently employed half time or more? _____

How many of these are age 16 or older? . . . . . _____

How many automobiles, including pick-up trucks, are available for use by members of your household? . . . . _____

What is the range of your total annual family income (before taxes)?

☐UNDER $5,000
☐$5,000–$6,999
☐$7,000–$9,999
☐$10,000–$14,999
☐$15,000–$19,999
☐$20,000–$24,999
☐$25,000–$49,999
☐$50,000 OR MORE

How much school have you completed?

☐LESS THAN HIGH SCHOOL GRADUATE
☐GRADUATED FROM HIGH SCHOOL
☐SOME COLLEGE
☐4 YEAR COLLEGE GRAD.
☐MORE THAN 4 YEARS OF COLLEGE

Which ethnic or racial category or categories describe you the closest?

☐AMERICAN INDIAN OR ALASKAN NATIVE
☐ASIAN OR PACIFIC ISLANDER
☐BLACK
☐SPANISH AMERICAN
☐WHITE
☐OTHER (SPECIFY) _____

WHEN YOU HAVE COMPLETED THIS QUESTIONNAIRE, SEAL IT IN THE ENVELOPE PROVIDED AND RETURN IT AS INSTRUCTED. THANK YOU

Figure A-5
REVISED (FINAL) QUESTIONNSIRE

Approved OMB No. 004S77010
Expires September, 1977

METROPOLITAN TRANSPORTATION COMMISSION

TRANSPORTATION SURVEY

The questions in this booklet are part of a survey being conducted by the Metropolitan Transportation Commission to help them plan better transportation facilities in the Bay Area. The survey is being sponsored by the U.S. Department of Transportation and the U.S. Department of Housing and Urban Development.

This survey is authorized by the U.S. Department of Transportation Act (P.L. 89-670, Sec. 4(2)). Your cooperation is needed to make the results of the survey comprehensive, accurate, and timely, although you are not required to respond. Neither your name nor that of your employer will be used in the survey. Only totals and averages for large groups of people will be reported. *If some questions don't seem to apply to your situation, or if you don't know the answer to a question, please write in an explanation.*

Figure A-5 (Continued)

Location of place where you work: _____
Number and street, or nearest intersection *City* *Zip*

What kind of work do you do? _____
(For example: TV repairman, spray painter, civil engineer)

What is your job title? _____

How long have you been working at this particular location? . . ____YEARS AND ____ MONTHS

Circle which days of the week you usually work at this location . . . . . MON TUES WED THURS FRI SAT SUN

On a typical work day, what are your work hours here? . . . . . ____ AM PM TO ____ AM PM

How important is it to you that your method of transportation to work never causes you to be more than ten minutes late? . . . . . ☐ VERY IMPORTANT
☐ SOMEWHAT IMPORTANT
☐ NOT IMPORTANT

Do you usually travel to work directly from your residence? . . . . . ☐ YES
☐ NO

We don't need your exact address, but we do need the following information about where you live: . . CITY _____ STREET _____

NEAREST INTERSECTING STREET _____ ZIP _____

How long have you lived there? . . . . . ___ YEARS AND ___ MONTHS

Do you own or rent your home? . . . . . ☐ OWN
☐ RENT

Where did you live before you moved to your present residence? _____
City *County* *State*

Did you own or rent there? . . . . . ☐ OWN
☐ RENT

Each of the next four pages is about a method of transportation some people use to get to work.

Please answer the questions about each one if you *use* the method, or if it would be *possible* for you to use the method as a substitute for your normal means of transportation.

Figure A-5 (Continued)

Is it possible for you to get to work by **WALKING** or riding a bicycle all the way? . . . . . ☐ YES, WALKING ☐ YES, RIDING A BIKE ☐ NO, NEITHER ONE

IF YOU CHECKED ONE OF THE "YES" BOXES, PLEASE ANSWER THE REST OF THE QUESTIONS ON THIS PAGE.

IF YOU CHECKED THE "NO" BOX PLEASE SKIP TO THE NEXT PAGE. ➡

How many minutes would it usually take for the entire door-to-door trip *to work*? . . . . . _____ MINUTES

Write in the number of days you actually use this method to get *to work* in a typical week. . . . . _____ DAYS

Given below are some factors which people consider in choosing their method of transportation. Listed beside each factor is a scale of scores from 1 to 7.

If you are very *satisfied* with a factor for this method of transportation you should circle 7. If you are very dissatisfied with a factor, you should circle 1. If you feel a factor is so-so circle 4, and so on along the scale.

	VERY SATISFIED						VERY DISSATISFIED
DEPENDABILITY OF ARRIVING ON TIME	7	6	5	4	3	2	1
SECURITY FROM CRIME AND UNPLEASANT BEHAVIOR OF OTHERS .	7	6	5	4	3	2	1
ABILITY TO DO WHAT YOU WANT WHILE TRAVELING	7	6	5	4	3	2	1
FLEXIBILITY TO TRAVEL WHEN YOU WANT TO	7	6	5	4	3	2	1
YOUR TOTAL DOOR-TO-DOOR TRAVEL TIME	7	6	5	4	3	2	1

PLEASE CONTINUE AT TOP OF NEXT PAGE

Figure A-5 (Continued)

Is it possible for you to travel to work on either BART or the Southern Pacific **TRAIN**? . . . . . ☐ YES, ON BART
☐ YES, ON S.P. TRAIN
☐ NO, NEITHER

IF YOU CHECKED ONE OF THE "YES" BOXES, PLEASE ANSWER THE REST OF THE QUESTIONS ON THIS PAGE.

IF YOU CHECKED THE "NO" BOX PLEASE SKIP TO THE NEXT PAGE.

At what station would you get on? . . . . . _____

At what station would you get off? . . . . . _____

How many minutes, including waiting time, would you usually spend going from one station to the other? _____MINUTES

How would you get to the train station on your way *to work*? . . . . . ☐ WALK
☐ BUS
☐ AUTOMOBILE
☐ OTHER _____

How many minutes, including waiting time, would it take you to get to the station? . . . . _____MINUTES

If by automobile: How many miles is it, one way? . . . . . _____ MILES

Please check how you would get from the station where you get off to the place where you work . . . . . ☐ WALK
☐ BUS
☐ OTHER _____

How many minutes, including waiting time, would it take to get from the station to work? . . _____MINUTES

Adding it all together, how many minutes would it usually take for the entire door-to-door trip? . . _____MINUTES

What is the fastest time you would expect? . . . . . _____MINUTES

What is the slowest time you would expect? . . . . . _____MINUTES

How many different vehicles and trains are used in the entire door-to-door trip from home *to work*? _____
(Include transfers in counting the number.)

How much is the daily round-trip cost for transit fares? . . . . . $_____

Write in the number of days you actually use this method to get to work in a typical week . . . _____ DAYS

Given below are some factors which people consider in choosing their method of transportation. Listed beside each factor is a scale of scores from 1 to 7.

If you are very *satisfied* with a factor for this method of transportation you should circle 7. If you are very dissatisfied with a factor, you should circle 1. If you feel a factor is so-so circle 4, and so on along the scale.

	VERY SATISFIED						VERY DISSATISFIED
TOTAL COST OF YOUR TRIP	7	6	5	4	3	2	1
YOUR WALKING TIME DURING THE TRIP	7	6	5	4	3	2	1
DEPENDABILITY OF ARRIVING ON TIME	7	6	5	4	3	2	1
YOUR CHANCES OF GETTING A SEAT	7	6	5	4	3	2	1
SECURITY FROM CRIME AND UNPLEASANT BEHAVIOR OF OTHERS	7	6	5	4	3	2	1
ABILITY TO DO WHAT YOU WANT WHILE TRAVELING	7	6	5	4	3	2	1
FLEXIBILITY TO TRAVEL WHEN YOU WANT TO	7	6	5	4	3	2	1
YOUR TOTAL DOOR-TO-DOOR TRAVEL TIME	7	6	5	4	3	2	1

PLEASE CONTINUE AT TOP OF NEXT PAGE

Figure A-5 (Continued)

Is it possible for you to use a **BUS**, streetcar, ferry boat or taxi as the main method of transportation to work? . . . . . ☐ YES, BUS ☐ YES, STREETCAR ☐ YES, FERRY BOAT ☐ YES, TAXI ☐ NO, NONE OF THEM

IF YOU CHECKED ANY OF THE "YES" BOXES, PLEASE ANSWER THE REST OF THE QUESTIONS ON THIS PAGE.

IF YOU CHECKED THE "NO" BOX PLEASE SKIP TO THE NEXT PAGE.

If you were to ride the bus or streetcar, please check which line you would ride and indicate the number or letter of the route . . . . . ☐ A.C. TRANSIT_____ ☐ GOLDEN GATE TRANSIT_____ ☐ GREYHOUND_____ ☐ S.F. MUNI_____ ☐ OTHER_____

Please indicate how many minutes, including waiting time, this part of the trip would usually take on your way *to work*. . . . . _____ MINUTES

Please check how you would get to the method of transportation checked above on your way *to work*. . . . . ☐ WALK ☐ BUS ☐ AUTOMOBILE ☐ OTHER _____

How many minutes, including waiting time, would this part of the trip usually take? . . . _____ MINUTES

If by automobile: How many miles is it, one way? . . . . . _____ MILES

How would you get from that method of transportation to the place where you work . . . . . ☐ WALK ☐ BUS ☐ OTHER_____

How many minutes, including waiting time, would this part of the trip usually take? . . . _____ MINUTES

Adding it all together, how many minutes would it usually take for the entire door-to-door trip? . _____ MINUTES

What is the fastest time you would expect? . . . . . _____ MINUTES

What is the slowest time you would expect? . . . . . _____ MINUTES

How many different vehicles are used in the entire door-to-door trip from home *to work*? . . . _____
(Include transfers in counting the number.)

How much is the daily round trip cost for transit fares? . . . . . $_____

Write in the number of days you actually use this method to get to work in a typical week. . . . _____ DAYS

Given below are some factors which people consider in choosing their method of transportation. Listed beside each factor is a scale of scores from 1 to 7.

If you are very *satisfied* with a factor for this method of transportation you should circle 7. If you are very dissatisfied with a factor, you should circle 1. If you feel a factor is so-so circle 4, and so on along the scale.

	VERY SATISFIED						VERY DISSATISFIED
TOTAL COST OF YOUR TRIP	7	6	5	4	3	2	1
YOUR WALKING TIME DURING THE TRIP	7	6	5	4	3	2	1
DEPENDABILITY OF ARRIVING ON TIME	7	6	5	4	3	2	1
YOUR CHANCES OF GETTING A SEAT	7	6	5	4	3	2	1
SECURITY FROM CRIME AND UNPLEASANT BEHAVIOR OF OTHERS	7	6	5	4	3	2	1
ABILITY TO DO WHAT YOU WANT WHILE TRAVELING	7	6	5	4	3	2	1
FLEXIBILITY TO TRAVEL WHEN YOU WANT TO	7	6	5	4	3	2	1
YOUR TOTAL DOOR-TO-DOOR TRAVEL TIME	7	6	5	4	3	2	1

PLEASE CONTINUE AT TOP OF NEXT PAGE

Figure A-5 (Continued)

Is it possible for you to travel to work by AUTOMOBILE, truck or motorcycle? . . . . . ☐ YES, BY AUTOMOBILE
☐ YES, BY TRUCK
☐ YES, BY MOTORCYCLE
☐ NO, NONE OF THEM

IF YOU CHECKED ANY OF THE "YES" BOXES, PLEASE ANSWER THE REST OF THE QUESTIONS ON THIS PAGE.

IF YOU CHECKED THE "NO" BOX PLEASE SKIP TO THE NEXT PAGE. ➡

How many miles is it from your home to the place where you work (one way)? . . . . . _____ MILES

How many minutes would it usually take for the entire door-to-door trip from home *to work*? . . . . . _____ MINUTES

What is the fastest time you would expect? . . . . . _____ MINUTES

What is the slowest time you would expect? . . . . . _____ MINUTES

How much would the daily round trip cost for— . . . . Bridge tolls . . . . . $_____

Parking fees . . . . . $_____

Write in the number of days you actually use this method to get to work in a typical week . . . . . _____

IF YOU EVER GO TO WORK BY THIS METHOD:

Do you drive alone or with a family member or do you ride in a carpool? . . . . . ☐ ALONE OR WITH FAMILY MEMBER
☐ IN A CARPOOL

How many people, including yourself, usually ride in the vehicle? . . . . . _____

Given below are some factors which people consider in choosing their method of transportation. Listed beside each factor is a scale of scores from 1 to 7.

If you are very *satisfied* with a factor for this method of transportation you should circle 7. If you are very dissatisfied with a factor, you should circle 1. If you feel a factor is so-so circle 4, and so on along the scale.

	VERY SATISFIED						VERY DISSATISFIED
TOTAL COST OF YOUR TRIP	7	6	5	4	3	2	1
YOUR WALKING TIME DURING THE TRIP	7	6	5	4	3	2	1
DEPENDABILITY OF ARRIVING ON TIME	7	6	5	4	3	2	1
SECURITY FROM CRIME AND UNPLEASANT BEHAVIOR OF OTHERS	7	6	5	4	3	2	1
ABILITY TO DO WHAT YOU WANT WHILE TRAVELING	7	6	5	4	3	2	1
FLEXIBILITY TO TRAVEL WHEN YOU WANT TO	7	6	5	4	3	2	1
YOUR TOTAL DOOR-TO-DOOR TRAVEL TIME	7	6	5	4	3	2	1

PLEASE CONTINUE AT TOP OF NEXT PAGE

Figure A-5 (Continued)

Which one method of getting to work would be your second choice, if your usual method were not available? . . . . _____

Please write in the most important reasons why your second choice method is not the one you usually use.
Write the most important reason first.

_____

_____

Do you drive an automobile or other motor vehicle? . . . . . ☐ YES ☐ NO

IF YES: Do you usually need a car for your work? . . . . . ☐ YES ☐ NO

IF YOU CAN DRIVE BUT USUALLY DON'T DRIVE TO WORK:

How easy would it be for you to obtain an automobile to drive to work? . . . ☐ VERY EASY
☐ A LITTLE DIFFICULT
☐ VERY DIFFICULT

Do you have any physical disability that has lasted six months or more, which limits or prevents your getting to or using any of the transportation methods listed on the preceding pages? . . . . . ☐ YES ☐ NO

IF YES: Please tell which methods of transportation are affected, and explain. _____

_____

What reasons led to your decision to accept your present job? . . . . . ☐ No choice, needed a job and this was the first one available.

CHECK THE BOXES NEXT TO THE REASONS THAT LED TO YOUR DECISION, THEN CIRCLE THE MOST IMPORTANT ONE.

☐ Transferred
☐ Other job-related reasons (better job, better pay, interesting work)
☐ Wanted to move to the Bay Area
☐ Convenient to home; shorter commute
☐ Wanted downtown location (convenient to shopping and other activities)
☐ Convenient to public transportation
☐ Other (specify)_____

_____

PLEASE CONTINUE WITH THE QUESTIONS ON THE BACK PAGE

WE WOULD LIKE SOME FURTHER INFORMATION ABOUT YOU TO HELP US ANALYZE THE SURVEY. AS YOUR NAME DOES NOT APPEAR ON THIS QUESTIONNAIRE, YOU CAN BE ASSURED OF ANONYMITY.

What is your sex? . . . . . ☐ MALE ☐ FEMALE

	NOW	12 MONTHS AGO
Including yourself, how many people live in your household? . .	_____	_____
How many of these are employed half time or more? . . .	_____	_____
How many of these are age 16 or older?	_____	
How many automobiles, including pick-up trucks, are available for use by members of your household?	_____	

How much school have you compieted? . . . . . ☐ LESS THAN HIGH SCHOOL GRADUATE ☐ GRADUATED FROM HIGH SCHOOL ☐ SOME COLLEGE ☐ 4-YEAR COLLEGE GRAD. ☐ MORE THAN 4 YEARS OF COLLEGE

What is your age? . . . . . _____

What is the range of your total annual family income? . . . . (before taxes)

CHECK THE APPROPRIATE BOX AT RIGHT, THEN DRAW A CIRCLE AROUND THE INCOME CATEGORY YOU WOULD HAVE CHECKED 12 MONTHS AGO.

☐ UNDER $5,000
☐ $5,000–$6,999
☐ $7,000–$9,999
☐ $10,000–$14,999
☐ $15,000–$19,999
☐ $20,000–$24,999
☐ $25,000–$49,999
☐ $50,000 OR MORE

Which ethnic or racial category or categories describe you the closest? . . . . . ☐ AMERICAN INDIAN OR ALASKAN NATIVE
☐ ASIAN OR PACIFIC ISLANDER
☐ BLACK
☐ SPANISH AMERICAN
☐ WHITE
☐ OTHER (SPECIFY): _____

WHEN YOU HAVE COMPLETED THIS QUESTIONNAIRE, SEAL IT IN THE ENVELOPE PROVIDED AND RETURN IT AS INSTRUCTED. THANK YOU.

Figure A-6
FIRST CONTACT LETTER

The Metropolitan Transportation Commission would like your help in its survey of the ways people in the Bay Area travel to work. This information will help update the regional transportation plan to reflect the changing needs and problems of commuters. Because of the importance of commuting to people, this study is sponsored by the U.S. Department of Transportation and the U.S. Department of Housing and Urban Development.

Your firm was chosen as part of a scientifically selected sample of all employers in the central Bay Area. You will soon be contacted by a representative of Management Information Associates, the survey research firm we have engaged to help us conduct the study. They will make arrangements with you to obtain the needed information from your employees. They will provide you with copies of a brief questionnaire to be filled out by a certain number of your employees, and will work with you to establish the best method for distributing and collecting the questionnaires.

Employee response is voluntary, but we hope you will encourage everyone given a questionnaire to cooperate so that our survey will produce a complete and accurate picture of work travel. All information from employees will be anonymous and your firm's name will not be used in our study report.

We will very much appreciate your assistance and cooperation when our survey research firm contacts you. If you have any questions in the meantime, please call us at 849-3223.

Sincerely,

Paul C. Watt
Executive Director

HOTEL CLAREMONT • BERKELEY, CALIFORNIA 94705 • (415) 849-3223

Figure A-7
FOLLOW-UP CONTACT LETTER

MANAGEMENT
INFORMATION
ASSOCIATES
26 O'FARRELL STREET • SAN FRANCISCO, CALIFORNIA 94108 • (415) 781-1305

Company Name:_____

Location:_____

Dear Employer:

We appreciate your willingness to help us in the employee survey we are carrying out for the Metropolitan Transportation Commission.

Please make sure that every person who works for your company in the above location receives a copy of a questionnaire and an envelope. This includes all persons on all shifts working at that location, including part time people, and owners or managers.

Make a list on Form A (attached) of all people to whom you give a copy of the questionnaire.

As questionnaires are returned to you, fill in the dates returned opposite the employee names, in the appropriate spaces on Form A. If an employee refuses to fill out a questionnaire, write "refused" opposite his or her name in the "date returned" column.

Please do everything you can to see that all questionnaires are returned by the time our representative returns to pick them up. He will return on:_____.

Don't forget to fill out one of the questionnaires yourself, if you work at the above location.

When our representative returns he will pick up all completed questionnaires and your copy of Form A. Please try to have them ready when he arrives.

Should you have any questions about the survey, don't hesitate to call Management Information Associates at 781-1305. Or, call Metropolitan Transportation Commission at 849-3223.

Thank you for your help.

METROPOLITAN TRANSPORTATION COMMISSION

TRANSPORTATION SURVEY

To ensure confidentiality of your response, this envelope is provided for returning your survey questionnaire directly to representatives of the Metropolitan Transportation Commission (MTC).

After you have answered all questions in your questionnaire, fold it and seal it in this envelope. The envelope will not be opened until after it leaves your company and is put together with questionnaires from many other companies.

At no time will your answers be identified with you. Instead, only totals and averages for large groups of people will be reported.

Thank you for your help.

Figure A-8
MAILING ENVELOPE

Figure A-9
LIST SHEET FOR EMPLOYERS

MANAGEMENT INFORMATION ASSOCIATES

26 O'Farrell Street, San Francisco

FORM A - MTC WORKPLACE SURVEY

Company name and address _____

EMPLOYEE LOCATION (FLOOR)	EMPLOYEE NAME	DATE GIVEN QUESTION-NAIRE	DATE RETURNED

Page___ of____Pages

IF FOR ANY REASON YOU DID NOT FILL OUT A QUESTIONNAIRE
IN THE MTC TRANSPORTATION SURVEY

Won't you please take just a minute to fill out this simple form. It will help to make the survey more accurate and representative of all who work in the Bay Area.

Please notice that you are not asked to identify yourself or your employer.

Please indicate the one method you use most often to get to and from work.

- ☐ WALK OR BICYCLE ALL THE WAY
- ☐ AUTOMOBILE (DRIVE ALONE OR CAR POOL), TRUCK, OR MOTORCYCLE
- ☐ BUS, STREETCAR, OR FERRY
- ☐ TRAIN (BART OR S.P.)
- ☐ OTHER: _____

How much school have you completed?

- ☐ LESS THAN HIGH SCHOOL GRADUATE
- ☐ GRADUATED FROM HIGH SCHOOL
- ☐ SOME COLLEGE
- ☐ 4 YEAR COLLEGE GRAD.
- ☐ MORE THAN 4 YEARS OF COLLEGE

What is your sex? . . . . . ☐ MALE ☐ FEMALE

What is your age? . . . . . _____

Which ethnic or racial category or categories describe you the closest?

- ☐ AMERICAN INDIAN OR ALASKAN NATIVE
- ☐ ASIAN OR PACIFIC ISLANDER
- ☐ BLACK
- ☐ SPANISH AMERICAN
- ☐ WHITE
- ☐ OTHER (SPECIFY): _____

WHEN YOU HAVE COMPLETED THIS QUESTIONNAIRE, SEAL IT IN THE ENVELOPE PROVIDED AND RETURN IT AS INSTRUCTED. THANK YOU.

Figure A-10
SHORT FORM QUESTIONNAIRE

APPENDIX B

EXPLANATORY MODELS OF MODE CHOICE

APPENDIX B

EXPLANATORY MODELS OF MODE CHOICE

In addition to attribute importance rankings obtained directly from questionnaire responses, estimates of the relative importance of the various attributes in travelers' mode choices were obtained from the coefficients of mathematical mode choice models estimated from the survey data.

These mode choice models express the probability of an individual choosing BART over bus or BART over automobile as a function of relative satisfaction ratings for the set of eight modal attributes listed in Tables 24 and 27. In estimating the models, the dependent variable is specified as a binary (1 or 0) variable depending on whether BART is the first or second choice mode. The explanatory variables are the differences in satisfaction ratings (BART minus second choice mode) for each of the eight attributes.

Two alternative model forms were estimated. One was a nonlinear form based on the logistic function (the logit model), for which the coefficients were inferred using maximum-likelihood estimation. The other was a linear functional form for which the model coefficients were inferred using least-squares regression. Ratios of the inferred coefficients of the models can be interpreted as measures of the relative importance attached to the various attributes by travelers in choosing their modes.*

*The assumptions and structure of the mode choice models are detailed in *Explanatory Modeling of Transbay Travel Choice*, BART Impact Program Document No. DOT-BIP-WP 34-3-77, Peat, Marwick, Mitchell & Co., October 1977.

Two sets of work travel survey data were analyzed: a BART-bus sample and a BART-automobile sample. The BART-bus sample included all people who specified BART as their first choice for travel to work and bus as their second choice, or vice versa. The BART-automobile choice sample was composed of all travelers having BART and "drive alone or with a family member" as their first and second choices.

The results of the explanatory mode choice models must be interpreted cautiously for several reasons. The models embody assumptions about people's travel behavior that are open to challenge. The limitations of the data set from which the model coefficients were estimated also have implications for the meaning of the results.

Perhaps the most important of these limitations is that, as with all statistical-inferential models, the procedures used to estimate the coefficients of the mode choice models depend on variation within the observed data. If little or no variation exists among the observations of individuals' satisfaction ratings for a particular attribute--if, for example, nearly all travelers rate their satisfaction with the safety of both BART and bus more-or-less equally highly--then this attribute will not be indicated by the model as a significant factor in their choice. This will be the case even though safety may well be very important to them in an absolute sense, or would be important if a choice were to be made between two modes, one of which was perceived as safe and one as unsafe. As a consequence, the estimates of relative importance produced by the models apply only to the circumstances of the specific travel choices for which the data were observed.

Nevertheless, the analyses of the attribute satisfaction ratings data show intuitively reasonable, internally consistent, and statistically significant results, and suggest that the coefficients of the mode choice models do form a reasonable basis for assessing the relative importance of modal attributes.

The coefficient estimates and statistics resulting from the BART-bus model estimations are summarized in Table B-1. Only coefficients whose t-statistics are significant at a 5% level are given. Importance ratings derived from the logit model results shown in Table B-1 (by dividing all coefficients by the largest coefficient) are given in Table 25.

Corresponding coefficient estimates and statistics for the BART-automobile sample are summarized in Table B-2. Derived importance ratings are given in Table 28.

Table B-1

BART-BUS CHOICE: MODEL ESTIMATION RESULTS

Modal Attribute	All Trips		CBD Trips		Non-CBD Trips		Transbay Trips	
	Linear Model	Logit Model	Linear Model	Logit Model	Linear Model	Logit Model	Linear Model	Logit Model
Walking Time	0.036	0.239	0.031	0.219	0.074	0.400	--	--
	(3.31)	(3.52)	(2.67)	(2.97)	(2.39)	(2.17)		
Dependability	0.028	0.165	0.026	0.157	--	--	0.080	0.487
	(2.95)	(2.99)	(2.40)	(2.52)			(4.85)	(3.72)
Activity En Route	0.040	0.229	0.042	0.254	--	--	0.056	0.473
	(3.94)	(3.69)	(3.64)	(3.49)			(3.70)	(3.30)
Total Time	0.047	0.260	0.053	0.297	0.057	0.302	0.036	0.279
	(4.74)	(4.44)	(4.80)	(4.47)	(2.96)	(2.68)	(2.36)	(2.34)
Constant	0.564	0.372	0.535	0.219	0.686	0.946	0.678	1.116
R^2 or Likelihood Ratio Index	0.282	0.242	0.302	0.264	0.203	0.212	0.418	0.421
F or Likelihood Ratio Statistic	51.9	179.4	47.1	160.9	11.7	28.0	40.1	99.9
Percent Correctly Classified	74.6	74.6	73.4	73.2	73.7	73.7	79.5	79.0
Sample Size	535		440		95		171	

Note: t-statistic given in parenthesis below coefficient.

Source: BART Impact Program, 1977 Work Travel Survey.

Table B-2

BART-AUTO CHOICE: MODEL ESTIMATION RESULTS

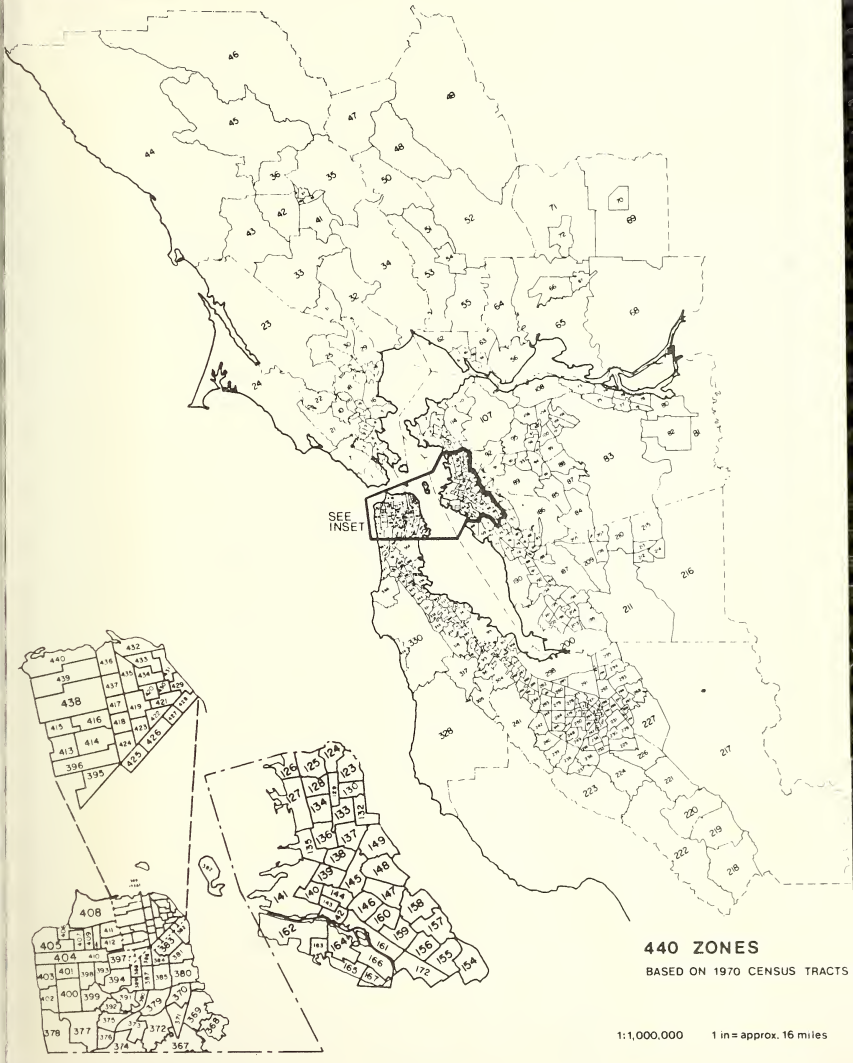
Modal Attribute	All Trips		CBD Trips		Non-CBD Trips		Transbay Trips	
	Linear Model	Logit Model	Linear Model	Logit Model	Linear Model	Logit Model	Linear Model	Logit Model
Total Cost	0.052 (7.14)	0.338 (6.59)	0.048 (4.82)	0.274 (4.27)	0.026 (2.87)	0.288 (2.94)	--	--
Walking Time	0.039 (4.23)	0.282 (4.43)	0.052 (3.50)	0.285 (3.03)	--	--	0.067 (2.02)	0.299 (1.87)
Security	0.026 (2.59)	0.176 (2.57)	--	--	0.038 (3.42)	0.403 (2.97)	--	--
Activity En Route	0.013 (2.11)	0.088 (2.24)	--	0.106 (2.09)	--	--	--	--
Total Time	0.048 (5.83)	0.277 (5.29)	0.070 (6.13)	0.360 (4.99)	0.027 (2.90)	0.216 (2.48)	--	--
Constant	0.574	0.450	0.726	1.145	0.302	-0.813	0.694	0.850
R^2 or Likelihood Ratio Index	0.303	0.307	0.271	0.259	0.148	0.537	0.062	0.116
F or Likelihood Ratio Statistic	54.4	269.0	41.5	121.6	16.7	218.0	4.1	10.3
Percent Correctly Classified	77.9	78.0	72.8	73.8	87.0	87.9	70.3	70.3
Sample Size	632		393		239		64	

Note: t-statistic given in parenthesis below coefficient.

Source: BART Impact Program, 1977 Work Travel Survey.

APPENDIX C

MTC ZONE SYSTEM


SEE INSET
440 ZONES
BASED ON 1970 CENSUS TRACTS
1:1,000,000 1 in = approx. 16 miles

APPENDIX D

GEOGRAPHIC DISTRIBUTION OF SAMPLE TRIPS
WEIGHTED AND UNWEIGHTED

GEOGRAPHIC DISTRIBUTION OF SAMPLE TRIPS
WEIGHTED AND UNWEIGHTED

Home Origin	Work Destination: San Francisco CBD	San Francisco Other	Oakland CBD	Oakland Other	Richmond Line	Concord Line	Fremont Line	Total
Daly City Line	1,048	182	34	22	5	4	16	1,311
	64,087	13,080	1,517	1,168	258	183	857	81,149
Oakland Line	96	8	218	139	68	10	126	665
	5,011	352	12,564	8,019	4,018	508	8,857	39,329
Richmond Line	88	13	96	90	284	15	53	639
	4,210	575	4,812	5,258	17,318	704	3,325	36,203
Concord Line	159	9	162	75	47	281	47	780
	7,347	595	7.081	4,378	2.603	16,105	2,495	40,606
Fremont Line	119	10	251	97	40	7	895	1,419
	6,568	876	13,650	6,244	2,416	491	70,718	100,963
Express Bus Area	60	5	81	31	52	156	74	459
	3,204	245	4,146	2,054	3,534	9,630	4,521	27,334
Other Areas	1,619	171	347	201	180	100	500	3,118
	87,241	11,560	17,365	12,020	10,179	6,369	35,659	180,393
Total	3,189	398	1,189	655	676	573	1,711	8,391
	177,668	27,284	61,135	39,141	40,326	33,991	126,432	505,977

Note: Top number in each cell is the unweighted sample size. Lower number is the weighted expansion, as described in the text, pp. 33-35.

Source: BART Impact Program, 1977 Work Travel Survey